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Dedication:

For my wonderful wife Valerie who has made me a better man.

*I could have been someone,
Well so could anyone,
You took my dreams from me,
When I first met you,
I kept them with me babe,
I put them with my own,
Can't make it all alone,
I've built my dream all around you.
(The Pogues, Fairytale of New York)*

For my beautiful daughter Caoilinn, my reminder of all that is good in this world.

In loving memory of my mother Kathleen Bond.

Abstract

A recent publication from the NCSE* (The Education of Deaf and Hard of Hearing Children in Ireland, 2011, p65) recommended that “The National Educational Psychological service should work towards a psychological service being available with a sufficient level of competency in ISL to administer psychological assessments and to communicate with parents and children whose preferred mode of communication is through ISL”. The research undertaken was to investigate the challenges that arise when cognitively assessing such children and to test assessments tools to try develop an awareness of best practice in the field (in line with NEPS draft recommendations).

The Wechsler Intelligence Scale for Children fourth edition (WISC-IV ^{UK}) was administered through ISL including the Verbal Comprehension Index, Working Memory Index and Processing Speed along with the traditional format of assessing Fluid Intelligence (Perceptual Reasoning) to establish a Full Scale I.Q. The Wechsler Non-Verbal Intelligence Scale of Ability, which requires no language input, was then administered to the same students (N=33)

In theory, both tests assert that they are assessing “Intelligence” or cognitive ability “g” and should produce similar if not identical I.Q scores. The research aimed to analyse these scores and see if they are consistent across the sample and examine any irregularities that might arise from the data.

Results showed that there was a very significant difference in the I.Q scores of the WNV and the WISC IV ($p<.0001$) and that there was a very large negative “effect size” for using ISL. Results would suggest that administering one of the most commonly used I.Q tests (WISC IV) actually discriminates against ISL users and is therefore contradictory towards the NCSE policy paper.

Issues that arose during the tests when using ISL interpreters for ISL users include translation of concepts that are not evident in ISL, the use of finger spelling and the issue of “back translation” whereby what is signed is not necessarily the same as what is spoken. This raises issues around the understatement of cognitive scores amongst the Deaf population and the difficulties that arise for educational psychologists in areas such as Working Memory, Verbal Comprehension Testing and the challenges of BICS and CALP.

- **National Council for Special Education.**

Precís.

As a child, my first introduction to the world of deafness was a deaf couple who visited my father regularly. My father was a tailor and many deaf individuals worked in this trade. I recall my parents writing line after line of writing into a notebook that passed from hand to hand much in the way a conversation passes from person to person. As an adult, I was introduced into the Deaf world via my wife who is a social worker and family therapist in an organisation called DeafHear.ie. My initial interactions with the Deaf Community were on “Family days” or “Zoo days” where I mixed with deaf adults and children. Much to my embarrassment, I could not communicate with anyone who used I.S.L. (Irish Sign Language) and could not even finger spell my name or indicate who I was other than by pointing to my wife.

I resolved to learn Irish Sign language as I knew I would be interacting with members of the Deaf community in the coming years. I did not anticipate that I would go on to work within the Deaf community as an educational psychologist but am glad that I sought to learn the language that Deaf people “speak”. I have trained for two years and have a very basic level of ISL which helps me introduce myself and tell people what I do. This is often called BICS: Basic Interpersonal Communication Skills.

I work as an educational psychologist in an organisation called NEPS: the National Educational Psychological Service. This is the main educational psychological service in Ireland comprising of approximately one hundred and eighty psychologists. All primary and post primary schools in Ireland are supported by NEPS and I work in one of six regions called the North Eastern region. The region covers Counties Louth, Meath, Cavan and Monaghan. Due to my interest in the area of deafness and hearing impairment, I have taken on the role of “Deaf/ Hearing Impaired co-ordinator” for my region. This involves supporting fellow educational psychologists in their work with Deaf/Hard of Hearing (D/HOH) students requiring psychological support. Due to the very low numbers of D/HOH children attending mainstream primary and post primary schools (at a regional and national level), I tend to co-work D/HOH cases when they present so that I can maintain my skill set in this area and

help up-skill my colleagues at the same time. In previous years I was allowed, by NEPS management to work, in two Deaf schools in Dublin which is outside my region while I was working on this thesis. This gave me an opportunity to develop my skills, my ISL and helped me network with other Deaf and Deaf-led organisations.

I had many opportunities to support D/HOH students in the specialist deaf schools as well as in mainstream settings and often did psychometric testing as part of my interventions with students. This is how I developed my interest in psychometric testing with deaf students: I had to work around issues that presented administering Intelligence Quotient (I.Q)/cognitive tests to deaf students as well as learning how to present my findings to their parents, whether they were deaf or hearing. NEPS have since developed guidelines on the cognitive assessment of deaf children (NEPS, 2011) but at the time it was a steep learning curve for me as I researched I.Q/cognitive testing in deaf populations.

The background to this research was the publication of “The Education of Deaf and Hard of Hearing Children in Ireland” (NCSE, 2011) by the National Council for Special Education. The guidelines have a particular reference to NEPS that interested me.

The NCSE recommend that “NEPS should work towards a psychological service being available with a sufficient level of competency in ISL to administer psychological assessment and to communicate with parents and children whose preferred mode of communication is through ISL” (NCSE, 2011, p65). While the Council acknowledges that “nonverbal tests of intelligence may often be fairer and more accurate” (IBID, p65) I was drawn by the recommendation that psychological assessment be delivered through ISL.

The Council acknowledged also that “It is difficult to achieve this level of technical proficiency in a language and that it requires significant time and opportunities to practice. In the meantime, ISL interpreters should be used for translation purposes, where necessary, when working with teachers, parents and children who are ISL users” (NCSE, 2011, p65).

My initial thoughts were that administering psychological tests through ISL would be interesting but likely to be challenging in many areas where an interpreter is used. My experience with working with interpreters when testing students who used ISL was that this method did nothing to “even the odds” or make an “even playing field” for students.

Questions arose as to whether the use of nonverbal tests of I.Q/cognitive ability were more accurate and fairer thus leading to a series of questions for this research. As an educational psychologist working in the area of deaf and hard of hearing students, I wanted to know what the best way was to cognitively assess D/HOH students. Specifically, should I test a student using a translator of ISL, test only using nonverbal tests of intelligence and what would be the impact of administering the most commonly used test (the Wechsler Intelligence scale for Children) using an interpreter ?

In order for any educational psychologist to work effectively in the area of D/HOH, they must understand the Deaf community and culture. A description of Irish Deaf education and the Irish Deaf community follows in which terms and information are described which will enable the reader to have an understanding that the cognitive testing of D/HOH students is a challenging and interesting subject to study.

Chapter One

1. Introduction.

This thesis attempts to evaluate two different methods of intelligence testing of Deaf and Hard of Hearing (D/HOH) students in the Irish educational system. The background for this research was the recommendation from the National Council for Special Education (NCSE) that cognitive assessment be carried out by psychologists from the National Educational Psychological Service (NEPS) in Irish Sign Language (ISL) or through the use of interpreters (NCSE, 2011, p65).

The researcher is a practising educational psychologist (E.P) in the NEPS and has a specialist role in the area of Hearing Impairment (HI). With the support of Deaf-led and Deaf organisations, the research was carried out with school-going students attending mainstream and specialist Deaf schools in the Republic of Ireland.

Participants were invited to participate through a variety of media: Web-based sites, letters to schools and through various connections with Deaf organisations. Two

cognitive tests were used in this research: The WISC IV^{U.K}, The Wechsler Intelligence Scale for Children, Fourth U.K edition (2004) the most commonly used cognitive test in the NEPS and the WNV, the Wechsler Non-Verbal Scale of Ability (2006). The WISC IV^{U.K} was administered through the use of an interpreter and comprises four main methods of testing intelligence: Verbal Comprehension, Perceptual Reasoning, Working Memory and Processing Speed. These four abilities are scored to produce a Full Scale I.Q (FSIQ). The WNV is a non-verbal test of ability which means that it is administered without the use of spoken or signed language. It produces a Full Scale I.Q comparable to that of the WISC IV (See Appendix A for a brief description and layout of both tests).

1.2 Hearing Loss.

Hearing loss is measured by audiologists in terms of an individuals' thresholds of detection across different frequencies. This ability (or inability) is averaged out to provide a diagnosis of Mild, Moderate, Severe or Profound hearing loss (HSE, 2011). Hearing loss therefore is identified by the loss of decibels (dB) detection in the best hearing ear. Table one describes how this loss is identified by an audiologist in Ireland. Hearing problems arise from impairment in the function of either the outer/middle ear, the inner ear or sometimes both. Impairment in the middle ear gives rise to conductive hearing loss while impairment in the inner ear (the cochlea) or to the nerve pathways leading from the cochlea is described as sensorineural hearing loss. The main methods of helping D/HOH individuals is to offer amplification through hearing aids or via cochlear implantation. Not every D/HOH individual with a sensorineural hearing loss is suitable for a cochlear implant.

Table 1. Classifications for Hearing Loss in Ireland.

Description of hearing loss	dB Hearing Loss in better ear averaged over range of frequencies (0.5, 1, 2 and 4 kHz of sound heard.
Mild	< 40 dB HL
Moderate	41-70 dB HL
Severe	71-95 dB HL
Profound	>95 dB HL

(NCSE, 2011)

Approximately two hundred children are born with disabling hearing loss in Ireland every year. Only ten percent of these children will be second-generation Deaf while

the other ninety percent will be born to hearing parents. These children will have challenges which will impact on their learning and education including:

- Impaired language acquisition
- Delayed cognitive development
- Social withdrawal
- Isolation
- Difficulty with literacy and numeracy
- Difficulty getting a job
- Statistically poor health and social inclusion

(DeafHear.ie, 2011)

One of the greatest breakthroughs in the early intervention of D/HOH children has been the New-born Screening Hearing Test. Traditionally children were screened for hearing as part of a developmental check-up. This meant that children were often left undiagnosed up to the age of two years and often as old as four. By this stage key language development was significantly delayed. In Ireland, Newborn Infant Hearing screening was only introduced on a limited availability in 2011. It only became available nation-wide two years later (Irish Examiner, 2011, <http://www.irishexaminer.com/ireland/health/national-newborn-hearing-screening-to-be-rolled-out-151393.html>). Considering that Newborn infant screening was introduced to the United States in 1999, Ireland has lagged behind international best practice for a considerable time. This has resulted in a population of “late diagnosed” D/HOH children who currently populate specialist Deaf schools as well as attending mainstream school: these are the children who have participated in this research.

1.3. Educational Background for D/HOH children.

Every second week a child is born without hearing or is Hearing Impaired (DeafHear.ie, 2015). This equates to three children in every one thousand children born and roughly to two hundred per annum. Previously, children born deaf/hard of hearing may have remained undiagnosed for many years. It was quite common for children to go undiagnosed for as long as four to five years (Marschark, 2009), however, with the introduction of Newborn Screening for Deafness, detection rates have been reduced to months rather than years (DeafHear.ie, 2015).

Approximately two thousand D/HOH children attend mainstream and special schools for the Deaf in Ireland (NCSE, 2011). Historically, Deaf education was centred on two main schools set in Dublin, the capital city of Ireland. They are St Joseph's School for Deaf Boys and St Mary's School for Deaf Girls based in Cabra, Dublin city. Currently, eighty girls attend St Mary's and seventy two boys attend St Joseph's. For over one hundred and fifty eight years religious orders have provided education to D/HOH boys and girls at the Cabra sites and both schools have been recognised as special schools for the Deaf for sixty three years. Up to twenty five years ago, parents of a D/HOH child had only one option in terms of education: Dublin. This meant that children as young as four became boarders in the Deaf schools and often only saw their parents over school holidays. ISL, Irish Sign Language was taught at the schools as a version of French Sign Language learnt from visiting Dominican Nuns from France. The Dominicans taught an Irish version of French sign language up to 1946 when Oralism was adopted as the preferred method of communication. Oralism was an approach that was originally proposed at the Milan World Conference in 1880. The philosophy behind this approach was one of integration: the thinking behind this approach was essentially "If Deaf people want

to be integrated then they need to be able to speak to Hearing People". Oralism in its approach was highly divisive as many Deaf schools proceeded to ban sign language. Like previous bans on the speaking of Irish language in schools, the ban on sign language never succeeded as the majority of the Deaf community rejected Oralism. Interestingly, due to the separation of the boys and the girls' schools, ISL signs have female and male versions of the same words. While students were often punished for using ISL the Oralism approach was never fully accepted by the Deaf community in Ireland and indeed around the world.

Twenty five years ago, the Midwest School for Hearing Impaired was established as a special school to accommodate children in the West of Ireland. Its main aim was to provide a viable alternative to sending children to Dublin for their education and to give young D/HOH children an opportunity to live at home with their parents/caregivers. Currently, the Midwest school for Hearing Impaired has less than twenty children. Numbers in the specialist Deaf schools have dropped for three main reasons: parents prefer to have their children attend a mainstream school rather than a special school and with the introduction of Newborn Screening for hearing difficulties, children are diagnosed much younger and often receive a cochlear implant which can aid their accessing a curriculum in a mainstream setting. A third and main reason for the dwindling attendance at the Deaf schools is due to the policies of the Department of Education and Skills through various acts of legislation: the Education Act (1998) the Education of People with Special Needs Act (EPSEN Act, 2009) and the Equality Act (2004). It is a policy of the Irish Government to include children with special needs into mainstream educational setting where possible and the Equality Act makes it an offense to exclude an individual on the basis of disability. Parents have preferred to have their D/HOH child attend

mainstream education in their local area rather than send them to boarding schools in Dublin.

Therefore, inclusive education for children with special needs has been a preferred option of the Department of Education and Skills in Ireland since 2004. The partial enactment of the EPSEN Act (The Education of Persons with Special Educational Needs Act, 2004) made inclusion a specific aim for the Department. The Act states “A child with special education needs shall be educated in an inclusive environment with children who do not have such needs” (EPSEN, Section 2, 2004, p5). This has encouraged D/HOH children to attend mainstream schools with the supports offered to them by the Department of Education and Skills. These supports can include: support from the Visiting Teacher for the Deaf, any audiological supports such as sound-field amplification, a Special Needs Assistant and specialist support of up to four hours a week from a resource teacher.

Currently there are fifteen special classes for D/HOH children attached to mainstream schools with approximately fifty students enrolled (NCSE, 2015). These schools are located in only eight counties in Ireland (Counties Clare, Cork, Longford, Cavan, Galway, Kerry, Offaly and Waterford, source: Special Education Administrative System, NCSE, 2015). This means that only eight of the twenty six counties in Ireland have educational provision for D/HOH children. The numbers enrolled in these small special classes lead to classes having several age groups and abilities within the same class.

At present, ISL, Irish sign Language is not recognised by the Government of Ireland as an official language of the Irish people. As a consequence of this, ISL translation support is not offered to D/HOH children in mainstream schools which forces some

parents/guardians of D/HOH children to make a choice between mainstream education and their preferred mode of communication. If a parent or a child wishes to be taught through ISL, the only option is attend one of the three Deaf schools or to attend a special class attached to a mainstream school. However, access to a teacher who is fluent in ISL is not guaranteed in the special classes attached to mainstream schools. As ninety per cent of D/HOH children are born to hearing parents (NCSE, 2011) one can expect that these children may grow up in a hearing-orientated world. Their parents or guardians may not see themselves or their family background as belonging to the Deaf world. Most literature make a clear distinction between “Big D” and “Little d” i.e. the term or identifier “D” refers to Deaf culture and norms while “d” as in “deaf” refers to D/HOH individuals who ascribe belonging and identity to the Hearing world and culture (Marschark, 2007).

In Ireland, up to twenty per cent of adults aged fifty years and older experience a disabling hearing loss. Over forty four per cent of people aged seventy years and older experience a disabling hearing loss (DeafHear.ie, 2015). At present, there are approximately seventeen per cent of the adult Irish population that can be described as having a disabling hearing loss. This represents over half a million people.

However, there are only five thousand people who identify themselves as Deaf: using ISL as their primary language. This is the Deaf community: a (relatively) small community of ISL users who identify themselves as a cultural group (IDA, 2015).

According to the Irish Census (CSO, 2011) more than five hundred thousand people speak a foreign language (Polish, French, Danish and Lithuanian) in Ireland while one million seven hundred people speak the Irish language (Gaelige). The Irish government recognises only the Irish Language and English as official languages.

Up to sixty thousand people can also use ISL to communicate but do not use it as their primary method of communication (IDS, 2015).

1.4. Irish Deaf Community

The Irish Deaf community see themselves as a distinct cultural group with its own identity and language. While the Irish Government identify D/HOH individuals as having a *disability* (it is the descriptor on the census forms), the Deaf community do not identify themselves as being “disabled”. A good example of this is the fact that D/HOH members of the Deaf community do not participate in the Special Olympics but rather in the Deaflympics (Deafsport.com, 2015). The Irish Deaf culture is described as having particular traits or identifiers such as Collectivism, Social Customs, ISL usage and Deaf culture (including drama, humour, folklore and organisations). DeafHear.ie, a registered charity which serves the Irish Deaf community, cite examples of social customs in the Deaf community such as particular ways of leaving a gathering and the necessity of giving a chronological description of an event rather than stating the basic facts. Deaf individuals have a strong sense of interconnectedness and often know family connections and relationships in great detail. As we will see in chapter three, there is a large distinction between second generation Deaf individuals (Deaf children of Deaf parents) and deaf children (of Hearing parents). The acquisition of language is a core difficulty for deaf children of Hearing parents and is one of the most challenging aspects of educating a D/HOH child (NCSE, 2011). Even a “mild” loss of hearing can severely affect the acquisition of language and can impair learning (NCSE, Ibid, p21). The Irish Health Service Executive’s National Audiology Review (2011, p13) states that “Hearing deficits not identified or addressed in a timely manner impact directly on communication ability, constrain development in children, lead to

limitations in everyday activities and restrict personal and social participation. They have demonstrable effects on health-related quality of life. In the case of children, these effects may be devastating for the child and family". This issue generally does not impact on second generation deaf children as they learn ISL from their deaf parents from birth.

1.5 Deaf Culture through History.

While a thorough knowledge of deaf history and development of the D/HOH community is essential when discussing D/HOH culture and experience, it is not the focus of this research. Some highlights might suffice to illustrate the journey of the D/HOH community to a place where there are now Deaf universities, Deaf artists, sportspeople and writers all of whom are leaders in their own fields.

In some of the oldest histories of the world, Deaf people were seen to be deficient in ability or intelligence: Hebrew Law forbade Deaf individuals from owning property and from marrying (Branson and Miller, 2002). Aristotle is often quoted for his ideas around Deaf individuals: "Those who are Born Deaf all become senseless and incapable of Reason" (Nomeland and Nomeland, 2011). In 430 A.D St Augustine declared that the Deaf were unintelligent as they cannot hear the Christian faith. He suggested that Deafness was a punishment from God for their parents' sins (Ibid).

The earliest record of the education of Deaf children was in 1550 when Pedro Ponce de Lyón developed a form of sign language and taught Deaf pupils to sign, write and read.

By 1864, Gallaudet University in the U.S.A., became the first Deaf University specifically aimed at the education of D/HOH individuals (Marschark and Spencer, 2010). This university has a long history of ground-breaking research and

educational influence in the D/HOH community in America. The response of Gallaudet to the aforementioned Milan Conference of 1880 was the rejection of Oralism and the pursuit for the recognition of American Sign Language (ASL) as a true “language” (Stoke, 2001). Finally, the first deaf president of Gallaudet University was elected following a student “revolt” in 1988 (Marschark and Spenser, 2010).

1.6 Irish Deaf History.

The Irish Deaf Hub (2014) have identified several historical highlights in the development of the Irish Deaf Community. They include: the opening of the first Deaf school in 1816, the opening of the Deaf schools in Cabra, Dublin, by Irish Catholic orders the Dominican Sisters and the Christian Brothers delineated along gender lines and their resistance to the Milan conference objectives around Oralism. The adoption of Oralism in 1945 by both Deaf schools under the direction of the Irish Government (The Education of Children who are Handicapped by Impaired Hearing, 1972) and the promotion of inclusion as a policy by the government of Ireland (The Report of the Special Education Review Committee, 1972). Finally in 2001, the Broadcast Act mandated the use of ISL for newscasts and the Disability Act (2004) defined deafness in terms of a disability. In 2012, Deaf Village Ireland was opened as a focus for the D/HOH community in which Deaf-led charities and organisations opened offices and a health club specifically to cater for the D/HOH community. The next section will investigate the concept of intelligence testing and how it refers specifically to D/HOH populations.

1.7 Intelligence Testing.

As the key research topic of this thesis is the intelligence testing (often referred to by E.P’s as cognitive assessment) of D/HOH children, it is essential to have a thorough

understanding of what intelligence is and how we, as a society, define intelligence. For the purpose of clarity it should be noted that “Intelligence testing” and “Cognitive testing/assessment” are terms that are interchangeable in their meaning throughout this thesis.

This section outlines the practice of intelligence testing in the United Kingdom and Ireland. It will identify the most commonly used test by educational psychologists in Ireland in particular and will briefly explain how an individual’s intelligence is calculated. This thesis is not specifically concerned with the history of intelligence testing or indeed alternate opinions on what psychologists should be measuring. However, if one is interested in the development of intelligence tests and their evolution, please consult with Appendix B which gives a brief outline. Indeed, if the reader is interested in the differing opinions on what intelligence is and what should be measured, they may wish to read Appendix C.

1.7.1 Intelligence

What is Intelligence? A definition of the noun “Intelligence” offered by the Cambridge Dictionary is “The ability to learn, understand, and make judgments or have opinions that are based on reason”. The Oxford Dictionary defines “Intelligence” as “The ability to acquire and apply knowledge and skills”. An interesting difference between the two definitions is the addition of the term “skills” in the Oxford Dictionary definition. However, for the purposes of this thesis, the author would like to offer a working definition of intelligence to mean “The ability to acquire and understand information and use this information to solve problems and challenges”.

Most people have an idea what being “intelligent” means: some would say that being intelligent involves academic success, others might argue that mathematical ability or problem-solving skills are more indicative of a person who is intelligent. Many people would argue that emotional intelligence is as important (if not more important) than traditional problem-solving measures cited as I.Q. (Goleman, 2000).

Daniel Goleman (ibid) has argued that a truly intelligent person is someone who is emotionally knowledgeable in many areas and can use this emotional knowledge to influence others.

However, in the world of psychology and in the field of educational psychology in particular, “Intelligence” means one thing: The I.Q score produced from an intelligence test. Most intelligence tests share a common conceptual base and have been formulated using the Cattell-Horn-Carroll theory of intelligence (CHC theory, Wechsler, 2004, P2). Intelligence is linked to the concept of **g**: general intelligence, which is the sum of many different strands of intelligence (Abilities) which are described in the next section. In pragmatic terms, in the Irish school system, intelligence is equated with an I.Q score obtained on an intelligence test. Having a high I.Q predicts that you should do well in academic tests such as the state-organised Junior and Leaving Certificate Examinations which students sit during second level education.

1.7.2 The Cattell-Horn-Carroll theory of intelligence

The Cattell-Horn-Carroll theory of intelligence established a statistical link between nine core abilities and over seventy narrow abilities with **g** has heavily influenced all intelligence tests used in modern time. The nine core abilities are as follows:

- *Fluid Intelligence (Gf)*: includes the broad ability to reason, form concepts, and solve problems using unfamiliar information or novel procedures.
- *Quantitative Reasoning (Gr)*: is the ability to comprehend quantitative concepts and relationships and to manipulate numerical symbols.
- *Long-Term Storage and Retrieval (Glr)*: is the ability to store information and fluently retrieve it later in the process of thinking.
- *Visual Processing (Gv)*: is the ability to perceive, analyse, synthesize, and think with visual patterns, including the ability to store and recall visual representations.
- *Crystallized Intelligence (Gc)*: includes the breadth and depth of a person's acquired knowledge, the ability to communicate one's knowledge, and the ability to reason using previously learned experiences or procedures.
- *Reading & Writing Ability (Grw)*: includes basic reading and writing skills.
- *Short-Term Memory (Gsm)*: is the ability to apprehend and hold information in immediate awareness and then use it within a few seconds.
- *Auditory Processing (Ga)*: is the ability to analyse, synthesize, and discriminate auditory stimuli, including the ability to process and discriminate speech sounds that may be presented under distorted conditions.
- *Processing Speed (Gs)*: is the ability to perform automatic cognitive tasks, particularly when measured under pressure to maintain focused attention (Flannigan and Kaufman, 2004).

A full description of the CHC theory and the structure of cognitive abilities is outlined in Flannigan and Kaufman (2004, pp295-309). Correlations between the two tests used in this research and the CHC concept of **g** is outlined in the methodology chapter.

Flannigan and Kaufman (ibid, p 14) state:

“Never before in the history of intelligence testing has a single theory (Indeed any theory) played so prominent a role in test development and interpretation”

These core abilities are tested in various subtests in all intelligence tests and are seen as the standard battery of tests necessary for measuring **g**. While the debate about using individual subtest scores to hypothesis around different individual abilities continues (Flannigan and Ortiz, 2001, Glutting, Mc Dermot and Konold, 1997), psychologists, and in particular, educational psychologists, require some individual (Ipsative) analysis in order to develop appropriate educational interventions (McCallum, Bracken and Wasserman, 2001). For example, in the Irish context, where there is a significant difference between Verbal Comprehension (Crystallized intelligence) and Perceptual Reasoning (Fluid Reasoning), this is a valid reason for referring a student for a speech and language therapist for further investigation. If a student displays very low Processing Speed they may be referred for an occupational therapist’s assessment. Individual (Ipsative) analysis of an individual’s performance is used when Irish educational psychologists write reports based on an intelligence test and attainment assessment.

1.7.3 Nonverbal Intelligence testing.

Since the first known non-verbal assessment of the Wild Boy of Aveyron (Carrey, 1995) many psychologists have tried to develop nonverbal means of assessing **g** (General intelligence). One of the most influential psychologists in this area was Seguin (1907) who developed puzzles using shapes which fit into a jigsaw-like form board which has been modified consistently and is still in use today. Another major contributor to the use of nonverbal testing was G. Arthur who produced the Arthur Point Scale of Performance test (1943, 1947). This test included the Seguin Form

Board, the Knox Cube Test (a forerunner of Block Design) and the Healy Picture Completion test. Arthur believed that his test would be on a par with the Stanford-Binet test in terms of measuring I.Q (intelligence). The Point scale was specifically intended for Deaf and Hard of Hearing individuals. Its goal was to provide a nonverbal battery of tests that would eliminate the language-loaded aspect of intelligence tests (McCallum, Bracken and Wasserman, 2001, p4).

As highlighted previously, there has always been a need to administer nonverbal tests to individuals and the key demand was that they were “culture fair” (McCallum, Bracken and Wasserman, 2001). However, Braden (1999) argued that, rather than aiming at producing culture fair tests, psychologists should endeavour to produce tests that measured intelligence (**g**) in a way that was independent of culture. Early attempts to produce nonverbal culture-free tests include the Leiter International Performance Scale (Leiter, 1959, 1997), Draw a Person (Goodenough, 1926) and the Columbia Mental Maturity Scale (Burgemeister, Blum and Lorge, 1972).

However, a combination of allowing the norms to become outdated and preference for the usage of Performance index/ batteries on wider language laden tests ensured that these earlier nonverbal tests fell into disuse. Bracken (1986 and Kaufman 1990 and 1994) have highlighted the fact that Performance subtests on much of the Wechsler tests have large amounts of lengthy verbal instructions and basic language concepts. Yet it is a commonplace practice to use these tests on Deaf and Hard of Hearing Individuals in Ireland (NEPS, 2012).

McCallum, Bracken and Wasserman (2001) have noted that increased awareness among psychologists about the limitations of using Performance index/batteries to assess **g** has led to a demand for more sophisticated and updated nonverbal tests. The list of non-verbal tests available to psychologists has grown in the last decade to

include: The Leiter International Performance Scale (1997), the Raven's Progressive Matrices (1999), Test of Nonverbal Intelligence (1997), the Naglieri Nonverbal Ability Test (1996) and the Universal Nonverbal Intelligence Test (1998). The Wechsler Nonverbal Test of Ability (2006) is the most modern test available to psychologists and has been specifically designed for specialist groups such as the Deaf and Hard of Hearing, students presenting with selective mutism and non-English speaking students (Brunnert, Naglieri and Hardy-Braz (2009, p6). It was the first cognitive test to be linked to data collected by Gallaudet University annual demographic survey of tens of thousands of Deaf and hard of Hearing students in the United States. It is also the first cognitive test to report separate validity studies for Deaf and Hard of Hearing students. It specifically "measures general ability non-verbally" (Brunnert, Naglieri and Hardy-Braz, 2009, p55).

McCallum, Bracken and Wasserman (2001, p9) state that "one could conclude that these instruments do in fact assess the same construct as language-loaded intelligence tests, and that is general intelligence".

While some tests (or parts of tests like the WISC-IV^{U.K}) are unidimensional, i.e. they test one aspect of intelligence such as Fluid Reasoning, modern nonverbal tests are multidimensional: the test uses several constructs that are summed to measure **g**. The Wechsler Non Verbal test used in this research uses Spatial Ability, Memory, Symbol Associations, Processing Speed and Sequencing Ability (**Gv**, **Gsm**, **Gs** and **Gf** in the Cattell–Horn–Carroll CHC model). Like the WISC IV^{U.K}, the four tests are calculated to give an overall score which is cited as the person's I.Q or intelligence.

1.7.4 Definition of Intelligence revisited.

It is significant that David Wechsler viewed intelligence not in terms of **capacity**, but rather, in terms of **performance**. That is, the Wechsler scales are not purported to measure one's quantity of intelligence, but instead measures one's intellectual performance. The rationale for conceptualizing intelligence as a performance variable is that it does not really matter how much intelligence one has per se. What matters is how well one uses or applies one's intelligence. Also, since intellectual capacity cannot be seen nor its existence concretely verified, it cannot be reliably measured. Performance can be measured and, thus, should be the focus of the test. Although Wechsler has written much to support this position, other intelligence developers have taken essentially the same position regarding the nature of intelligence. Most major intelligence tests, such as the Stanford-Binet (2014) are grounded in the view of intelligence tests as performance measures. Therefore, we can posit that "Intelligence" is a measurable construct in the performance of tasks that challenge our ability to problem-solve and apply our knowledge gained from interacting with our environment. The reality is that many people are highly intelligent but do not utilise their ability in day-to-day functioning. Society tends to value those individuals who apply their intelligence in a real-life situation: an exam, a production of a report or in an aptitude test. Whether one is tested verbally or nonverbally, the product of the test is a measure of one's intellectual performance: **g**.

1.8 Alternative Views on Intelligence: Beyond I.Q.

While the practice of testing students is very well established in modern societies (especially Western Society), there have been demands for a broader, more humanistic way of looking at individual's strengths as part of their personal skills or

abilities. As mentioned in the previous section, I.Q tests essentially test the ability to perform in a challenging situation through learnt knowledge and fluid reasoning skills. They predict, in the main, academic outcomes rather than life outcomes. They do not predict a person's skills on a broad range of skills and adaptations to the society they live in. Many people have personal knowledge of highly intelligent individuals who are not good at communicating with people or simply "getting on" with others. The stereotypical character of the "boffin" or "geek" in cinema abounds from Sherlock Holmes, House M.D or British cryptanalyst Alan Turing: super-intelligent individuals who are more interested in puzzles than people.

In society, it may not be enough to be brilliant and have a high I.Q. In Ireland today, doctors have to take aptitude tests to show that they can communicate and empathise with patients. Having six or seven straight "A's" no longer meets the criteria for entry to the College of Surgeons. The HPAT, the Health Professional Aptitude Test is used by Irish colleges to identify individuals who may have excellent academic ability but lack social communication skills (<http://www.hpat-ireland.acer.edu.au/>).

Some theorists and researchers have argued that there is a need for a broader conceptualisation of the term "Intelligence". Appendix C outlines the concept of "Multiple Intelligence" and also explains the concept of "Emotional Intelligence". However neither concepts are utilised by educational psychologists as a way of testing Intelligence and therefore are not used in this research. A full description of the Intelligence tests used in this research are identified and explained fully in the Methodology Chapter.

Conclusion.

This chapter has introduced the beginnings of the present research topic: the use of intelligence tests with D/HOH students in an Irish educational setting. The identification, population and brief history of the Deaf in Ireland was explored along with short highlights of world and Irish events of note in the Deaf world.

A brief discussion of the development of cognitive testing was undertaken to familiarise the reader with the major contributors to this field. A more in-depth discussion of the history of intelligence testing is outlined in Appendix B. While not everyone agrees with the relevance of I.Q testing beyond the prediction of academic success, it is clear that the most common method of testing ability in school-going children is the usage of the Cattell-Horn-Carroll conceptualisation of ***g*** or *general intelligence*. The WISC IV^{U.K} and the Wechsler Nonverbal scale of Ability are the instruments used in this research and are based on the CHC model of intelligence.

Alternative views on what intelligence is are outlined and illustrated in Appendix C and E under the titles of: Multiple Intelligences (M.I) and Emotional Intelligence (E.I). Studies have shown that there is little correlation between either E.I or M.I and academic outcomes. Many researchers have questioned the use of the term “Intelligence” in both E.I and M.I and have argued that the term ability might be a better way of describing these traits. The reality is that neither M.I nor E.I is used as a method for assessing the ability of school-going children in Ireland. As noted earlier, the Irish state tests second-level pupils in a terminal exam called the Leaving Certificate during the last month of the last year of second-level education. I.Q tests that measure ***g*** show a high correlation between high ***g*** and high grades on the Leaving Certificate. In a pragmatic sense, educational psychologists in Ireland test

I.Q to predict strengths and weaknesses in individual children to inform educational interventions. This is called Ipsative analysis.

Ipsative analysis is commonplace with practising E.P's in Ireland. While educational psychologists endeavour to highlight strengths and character ability (such as being able to make friends and being confident), test results are the main focus of reports. This approach has led to the adoption of a pragmatic epistemological approach towards the research and will be explained more fully in the methodology chapter. The next chapters will investigate the current and historical research into the cognitive assessment (Intelligence testing) of D/HOH children and will identify the topics that informed the present research. The use of questions will be a theme of this study in an attempt to focus on the kind of questions that this research attempts to answer.

The following chapters will cover aspects of the research including a review of topics relevant to the present research including how intelligence is tested in the D/HOH population (Chapter Two) and a critical overview of issues pertinent to research with D/HOH populations. This will include topics on language development, theory of mind and the use of sign language interpreters with H/HOH students (Chapter Three). Chapter Four will identify the methodologies used and the epistemological framework which informed the decisions that underpinned the practical and philosophical approach used when using and interpreting intelligence tests with D/HOH participants. The final two chapters are dedicated to the results obtained from the statistical analysis of the data obtained from the intelligence tests and a commentary on the responses given in the semi-structured interviews held with the D/HOH participants (Chapter Five). Chapter Five will also illustrate the challenges that can occur when using sign language interpreters to administer intelligence tests.

The final chapter include a commentary on the linkage between the research findings and previous research. It will offer final conclusions and recommendations for practising educational psychologists.

Chapter Two.

2.1 Introduction and General Background.

This chapter is dedicated to the key research question of the present study: Intelligence testing in D/HOH populations. It will identify a historical context in which intelligence testing developed and will then look at intelligence testing of D/HOH populations specifically. It will introduce the linkage between the use of sign language as a mode of communication and how this was suppressed by institutions all over Europe in the early 20th Century.

Intelligence testing in the Deaf community is a topic that has been investigated since intelligence testing began in the latter half of the 19th century (Flanagan and Kaufman, 2004). The questions that have arisen through this research are ones that are both pragmatic and philosophical in nature: early research was interested in the idea of intelligence in the absence of language, the questions raised were linked to the idea that perhaps one needed language to “Think” or to “Reason” thus questioning the very intelligence of D/HOH people. They asked questions like; “can D/HOH people reason like Hearing people?” and “How does intelligence develop in the absence of language?”

2.2 Intelligence and Deafness.

Historically, psychologists and researchers have sought to test the intelligence of D/HOH populations to aid educational interventions and to suggest educational placements. Braden, (1994) in his seminal book called “Deafness, Deprivation and I.Q,” highlights the development of intelligence testing of the D/HOH population. For example, Pintner (Pinter and Paterson, 1915a) was the first to use Binet’s intelligence tests on Deaf individuals to study the effects of language development

on intelligence in D/HOH individuals. Intelligence testing was carried out to compare the development of D/HOH children in different educational settings. Pintner, in 1928, concluded that deafness caused a delay in cognitive development which he called mental retardation. The pragmatic response to his finding resulted in D/HOH students being educated in special schools and deemed unable to access mainstream education (Braden, 1994). Heumann (1991) stated that it took “more than four decades of research to refute Pintner’s erroneous claim”.

Vernon (1967c) reported on the severe delay in language of D/HOH children. He noted that four year old D/HOH children knew fewer than one hundred words compared to hearing children who knew, on average, two thousand to four thousand words. It was thought that the delay in language would imply a significantly lower level of intellect in the D/HOH population. Myklebust (1964) was one of the first investigators in the field of deaf intelligence testing to suggest that the lack of language development may change the structure and organisation of deaf individual’s intelligence. This suggestion lead to investigations around the very nature of intelligence testing in the deaf population. It became very clear in the initial development of testing D/HOH individuals that tests involving language would result in significantly lower I.Q scores in these populations when results were compared to norms based on a hearing population (Pintner, Eisenson and Stanton, 1946).

Therefore, intelligence tests which omitted the verbal comprehension aspects of intelligence testing produced I.Q average scores in the Average to Low-Average range while tests that included language components produced average I.Q levels for D/HOH individuals in the Borderline and Mild General Learning Difficulty ranges (Vernon 1967c).

The Wechsler series of intelligence tests categorise scores as follows:

- Average range: 90-110 Standard Score
- Low Average Range 80-89 Standard score
- Borderline Mild General Learning Difficulty: 70-79 Standard Score
- Extremely Low: 69 and Below. Standard Score.

Vernon (1967, c) cited three main conclusions around the early history of intelligence testing in the deaf population that are worth citing:

- There is no functional relationship between verbal language and cognition or thought processes.
- Verbal Language is not the mediating symbol system of thought
- There is no relationship between concept formation and level of verbal language development (Vernon, 1967c. p331)

Braden (1994) carried out a meta-analysis of intelligence testing over 324 independent samples with 171,517 participants providing what he describes as “the largest single compilation of data describing deaf people’s intelligence to date” (Ibid, p.65). He reported that there was a positive and statistically significant relationship between the year of the testing and reported average I.Q. of D/HOH populations: the older the test, the more likely a lower I.Q was reported for D/HOH individuals.

Braden suggests two possible reasons for this result: poor test materials and the possibility that D/HOH individuals were “catching up” with hearing individuals (ibid. p68): this would suggest the possibility of the Flynn Effect (Herrnstein and Murray, 1994) in a D/HOH population while not evident in a Hearing population which does not make sense in the author’s opinion. The Flynn Effect is a theory that posits that I.Q scores rise gradually over time as test materials come into the public domain and people in general become smarter. There is no reason to believe that one particular

section of a population would experience a Flynn Effect in isolation. The most likely answer for the increasing reported I.Q scores among the D/HOH population was the increased sophistication of tests and a greater awareness of the need to omit language-based subtests in I.Q measures.

In line with previous research, Braden (1994) reports that tests of I.Q that utilise verbal comprehension yield lower average I.Q scores in the D/HOH population. Tests that use Performance items (fluid reasoning tests) yield the highest average test scores. Braden also reported on the link between verbal comprehension and academic outcomes. It is documented that D/HOH people traditionally perform much poorer than their hearing peers in academic skills such as reading, reading comprehension and problem-solving mathematics (Marschark, 2010, Leeson, 2012).

Intelligence tests such as the Wechsler series are highly correlated with academic outcomes. The higher the I.Q the better the student will fare in tests of academic ability (Flanagan and Kaufman, 2004). Miller (1984) used American Sign Language and signed English to test the intelligence of D/HOH students. Results placed the D/HOH children within the Average range for Verbal Comprehension. It must be noted however, that Miller removed the scores for Vocabulary when calculating Verbal Comprehension. This was due to the fact that the Vocabulary subtest would be affected by an underdeveloped language acquisition process/system in the D/HOH participants (Braden, 1994). Thus this research was not an accurate reflection of **g**. One cannot cite a Full Scale I.Q (FSIQ) while removing one of the subtests.

The majority of tests involved in the Braden sample involved either tests of nonverbal performance abilities or motor-free tests of performance. The difference between

these two types of tests are relatively simple to explain: one test involves tests that can be answered by pointing or signalling while the other test requires the participant to manipulate materials (for example Block Design involves using blocks to copy a shape shown on a page which is timed while Matrix Reasoning involves watching for a pattern in a sample and pointing out the answer). The mean for the samples used in Braden's meta-analysis indicated Average I.Q's for Performance tests (Mean=99.95) and a lower Average I.Q for motor-free performance tests (Mean=94.57). This is compared to a mean of 100 for Hearing peers. Braden reports that "the mean (and standard deviation) of D/HOH people's PIQ (Performance I.Q) are virtually identical to the distribution of PIQ's in normal-hearing people (Braden, 1994, p83). Braden has proposed elsewhere (Braden, 1985a and 1987) that the use and exposure to sign language enables D/HOH individuals to perform faster on tests of motor skills used on Performance I.Q testing. This concept has implications for the present research in that the WISC IV^{U.K} includes one motor subtest within the Performance I.Q battery (Block Design) and one on the Wechsler Non-Verbal test of Intelligence (Processing Speed). It must be noted that the Performance I.Q is associated with the WISC III and is no longer used as modifications of the WISC-IV^{U.K} split Performance I.Q skills into Perceptual Reasoning and Processing Speed (See Flanagan and Kaufman, 2004, p247).

Braden also addressed the issue of how tests were administered to D/HOH individuals. He cites Goetzinger and Rousey (1957) who reported that slightly lower PIQ's reported by researcher were due to administration factors and not to any underlying difference in the distribution of PIQ among D/HOH people (Braden, 1994, P83). Sullivan (1982) has supported this opinion by administering I.Q. tests (Wechsler) via Total Communication, an Interpreter and oral methods. She

concluded that Total Communication methods of administration yielded significantly higher PIQ scores over other methods of administration. Braden concludes that “methods approximating the modes of communication used by the D/HOH community yield IQ’s closer to the normal-hearing group” (1994, p84). Braden highlights two ways in which the method of test administration is delivered can affect I.Q. scores: the first is where the participant does not understand what they are expected to do (Braden, 1994, P154) while the other is content aspects of subtests. The participant is not being tested in their primary language (i.e. sign language or L1) but in the standard language of hearing people (which is a second language, L2). He reports that “Experimental evidence, meta-analytic findings and clinical recommendations all concur that administration in standard modalities severely depress the I.Q’s obtained by Deaf people” (Ibid, p154).

Intelligence is a composite construct involving various variables including age, educational level, social level, environmental stimulation educational level of parents and genetics (Nisbett, Aronson, Blair, Dickens, Flynn, Halpern and Turkheimer, 2012). It can be inferred that such variables should also be considered when testing the intelligence of D/HOH individuals (Kushalnagar, Krull, Hannay, Mehta, Caudle and Oghalai, 2007, and Krouse and Braden, 2011).

One might question the validity of testing any form of I.Q. that utilises verbal comprehension components for D/HOH populations. Akamatsu, Mayer and Hardy-Braz (2008) have argued that psychologists should have cognisance of the language levels of students so that educators can implement and optimise support for such children (see also Hauser et al 2008). This has validity for the present research in that the results of Full Scale I.Qs incorporating VCI (Verbal Comprehension) yielded significantly lower I.Qs than those obtained by PRI (Perceptual Reasoning)

One should not ignore Verbal Comprehension scores outright in that they can provide the examiner with useful information which may be used to support educational and personal interventions (Ipsative analysis).

Maller (2003) and Maller and Braden (1993) have also shown that the average test scores for I.Q on D/HOH children do not differ significantly from hearing peers on tests of nonverbal cognitive functioning. However, tests which included verbal intelligence were reported as a full standard deviation below that of their hearing peers. Huber and Kipman (2012) have also reported that D/HOH children achieve lower scores on crystallised intelligence such as Vocabulary, Comprehension and Similarities on the WISC III and that cognitive skills are correlated significantly with academic outcomes. Huber and Kipman (2012) have suggested that nonverbal tests of intelligence may be more appropriate than verbal ones for the D/HOH population. Wood and Dockrell (2012) stated that it is important to know the cognitive differences between D/HOH and Hearing children when planning intervention strategies, hence the need to know what scores D/HOH children attain on Verbal Comprehension tests in I.Q testing.

Recent research has investigated the validity of using the WISC IV with a Deaf population (Krouse and Braden, 2011) and has concluded that “this study generally supports the internal consistency reliability of WISC IV scores for D/HOH children” (ibid, p247). They note that there was a significant change in the composition of the Wechsler test from the WISC III to the WISC IV. The main change was the elimination of performance items from the Perceptual Reasoning Index (Fluid Reasoning I.Q). As previously argued (Braden, 1994), D/HOH individuals tend to score well in Performance I.Q (PIQ) tests whereas now the Perceptual Reasoning

I.Q index tests of the WISC IV have removed this “advantage” for D/HOH individuals. We might expect a lower mean for this population in the light of this change.

Krouse and Braden (2011) collected data from ten psychologists who provided WISC IV score results on 128 examinees who were identified as having a pre-lingual loss, having a Mild to Profound hearing loss and having a hearing impairment as their primary disability (ibid, p240). They found that the mean PRI (Perceptual Reasoning Index-Fluid Reasoning) was *lower* than the mean for the normative sample (93.21 vs. 100 Standard Score). They state that “This finding is not consistent with research from the previous versions of the Wechsler Scales suggesting that PRI and WISC-III PIQ (Performance I.Q) are not comparable. The suggestion is that the WISC-IV reduces visual-spatial and motor skills input into the test and, in fact, the PRI is more “non-verbal reasoning” hence producing a more accurate reading of Fluid Reasoning. In the WISC-IV the Block Design subtest (which was present in the WISC-III Performance I.Q) was less influenced by the speed of completion thus reducing performance advantage (Ibid, p246).

It is important to note that the Verbal Comprehension I.Q index (VCI) mean scores for D/HOH were significantly lower than that of the normed (Hearing) population. The mean VCI was reported as 80.86 and was in line with previous I.Q tests used on a Deaf population (Krouse and Braden 2011, p246). This is an interesting and important piece of research in relation to the present research in that many of the tests were administered via ASL, Total Communication and Signed and Spoken English. A total of 18 tests were administered orally leaving 110 tests being delivered via some form of sign language. Krouse and Braden (Ibid, p246) reiterate the advice that “In general, verbal tests of intelligence are not recommended for the cognitive assessment of D/HOH children”.

This research aims at producing evidence that this assertion is applicable for the Irish D/HOH population. Despite the fact that one of the authors (Jeffery Braden) is an acknowledged expert in the field of cognitive assessment of D/HOH populations there are many aspects of the methodology previously undertaken that need to be refined and improved in this present research. Krouse and Braden (2011) cite limitations such as difficulties around the collection of data. They acknowledge that they had no control over the test administration parameters (sign use, hearing aid checks, psychologist certification and adherence to standard protocols) and acknowledge that the use of archival data is likely to increase error (Ibid, p247). They argue that the data available however “captures authentic practice conditions” (Ibid, p247). The variability of items such as qualification of the psychologists, their knowledge of Deaf culture and their ability to use sign language as well as an important issue of obtaining informed consent make this research weaker (though still important) in the opinion of the researcher. They clearly state that the Full Scale I.Q of the WISC-IV should never be used as an identification of a D/HOH child’s intelligence as it is likely that the VCI will depress the overall FSIQ score. Flannigan and Ortiz, (2001) and Flannigan, Ortiz and Alfonso (2007) have also highlighted the issue of using Verbal Comprehension (Crystallised Intelligence, **Gc**) on a D/HOH population as it includes “Breadth and depth knowledge of a culture developed through an investment of abilities in learning through education....the ability to communicate and to reason with previously learned procedures” (Cited in Miller, 2008, p.23).

Marschark, Convertino, Macias, Monikowski, Sapere and Seewagen (2007) highlighted an issue that could potentially impact on D/HOH students’ understanding of instructions given during I.Q. testing: they noted that D/HOH students lack the

recognition of misunderstandings and are unwilling to seek clarification and restatement of question. If examiners do not request clarification during testing there is a chance that instructions may be misunderstood. A way of looking at the issue of testing D/HOH individuals is summarised in the oft quoted phrase by Marschark and Hauser (2008): "Deaf and Hard of Hearing individuals are not just Hearing individuals who cannot hear" (Marschark and Hauser 2008, <http://www.rit.edu/showcase/index.php?id=86>)

Another issue in the delivery of items in I.Q tests is the use of sign language when administering certain items such as Digit Span, Digit Span backwards and Letter-Number Sequencing which are subtests of the WISC-IV^{UK} Working Memory Index (WMI). Lichtenstein (1998) and Marschark and Mayer (1998) have highlighted issues around memory capacity such as coding via sign language. They have reported that signed items can take up more time to memorise as well as taking up more mental space thus reducing the capacity of the signing D/HOH participant to do well in these particular test items. Tests such as Digit Span and Letter-Number Sequencing operate by testing auditory Working Memory which is assumed to be effective for no more than 4-6 seconds (Baddeley and Hitch, 1974). Signing numbers in general takes longer than saying them thus compromising Working Memory and making the test invalid. There is also a question as to whether the same construct is being tested: there is a difference between auditory short term working memory and visual short term working memory. When using sign to test working memory there may be an issue with construct validity. This would be another reason why a WISC IV^{U.K} FSIQ should not be computed for D/HOH populations.

There are many questions raised around the use of standardised tests that have been normed on the Hearing population. Barbosa, Lukasove, Mecca and Macedo

(2013) however have suggested that tests normed on a Hearing population can be used when testing D/HOH participants. They used the TONI 3 (Test of Non-Verbal Intelligence) on 205 D/HOH children (Male and female participants with an average age of 14yrs). No significant differences were found between genders, type of deafness or communication mode in terms of deaf children compared to normal-hearing children. They found that the TONI 3 was a valid test of intelligence in Brazilian D/HOH students. Clearly, tests of nonverbal intelligence are more suited to the task of measuring the Fluid Reasoning of D/HOH populations.

It is clear that the improper use of testing instruments can under estimate or misdiagnose D/HOH children's abilities. Krivitski, (2000) reported that the use of inadequate instruments by psychologists often label D/HOH children as having a developmental delay and under report cognitive ability. Bishop (2005) assessed the development of intelligence tests in the 1990's and how traditional tests had significant errors in I.Q scores for D/HOH populations. Rose, Barkmeier, Landrud, Klansek-Kyllo, McAnally, Larson and Hoekstea (2008) produced some excellent recommendations in their publication: "The Assessment of Children Who are Deaf and Hard of Hearing". They highlighted the difficulties that school psychologists have when testing D/HOH children. They argued that psychologists must have fluency in the D/HOH child's first language (American sign language was cited) and suggested that lack of knowledge of sign and Deaf culture can "weaken the assessor's confidence and alter the standardised test procedure or even invalidate the results" (Ibid, p15) Larson and Hoekstea (2008) also argued against the adaptation of test items, the adaptation of time limits and accepting responses different than those specified in the test manual. An issue of adapting time limits and accepting adapted responses invalidate the test in terms of using scores to compare to the normed

population. An example of this would be the use of sign language to administer Digit-Span and Letter-Number Sequencing on the WISC-IV^{U.K.}

Traditionally Performance scales (PIQ) were accepted as indicators of cognitive ability in D/HOH populations. Sattler (2001), however, argued that administration adaptations during application alter the standard testing format thus making the test invalid. If tests were or are normed on a Hearing population and signs or gestures were not used when these tests were normed then to use signs or gestures typically invalidated the test.

They also noted that an assumption can be made that the D/HOH child has been exposed to the linguistic semantic and pragmatic information inherent in the test items in a manner that is similar to those in the normative sample is not a valid assumption (See also Braden and Athanasiou, 2005). Given the traditional late diagnosis of D/HOH children, we can assume that language development can be compromised. Essentially the D/HOH child is being tested in an L2 (Second language) rather than their preferred L1 (First language). This issue is addressed in the next chapter.

Mackinson, Leigh, Blennerhassett and Anthony (1997) itemised criteria for developing non-verbal tests for the D/HOH population. They highlighted the type of instructions given by the tester, the type of answer elicited by the testee and the loading of cultural content as well as whether certain tests were timed or not. This is important as it notes how language and language comprehension can affect performance on intelligence tests for D/HOH participants. While intelligence tests for D/HOH populations should ideally not have a large language loading, they should

also not be too loaded in terms of motor skills as D/HOH populations also perform better than Hearing populations in such tests (Braden, 1994).

Barbosa, Lukasove, Mecca and Macedo (2013) argued that tests free of verbal and cultural skills should also have low motor skills demand (see also Braden, 1994). This would fit in well with the use of the WISC-IV^{U.K} following Krouse and Braden's (2011) findings.

Sternberg (1989) argued that the basic premise that cognition or intelligence is multi-facetted and reflected in the coordinated performance of numerous language and non-language tasks. Therefore, the use of non-verbal tests are just as valid for calculating I.Q scores for individuals. Sternberg (1989) argued that intelligence tests were originally designed to predict academic performance. A natural question to ask then is "Could it be possible that the lower than average academic achievement reported in the D/HOH community are a result of lower than average I.Q.?"

Bond (1987) reported that the performance of D/HOH pre-schoolers on nonverbal subtests was unrelated to the severity of their hearing loss. This is interesting in two ways: it suggests that the tests are actually testing fluid intelligence (i.e. Non-verbal I.Q.) and that hearing loss and its association with language development has no effect on the performance of D/HOH children in tests of non-verbal I.Q. It may mean, however that at a very young age, D/HOH children's language development delay may not be significantly different to that of their hearing peers.

Deaf children of Deaf parents (second generation Deaf), score higher mean performance scores than either D/HOH children of Hearing parents or Hearing children of Hearing parents (Sisco and Anderson, 1980) on tests that involve PIQ (WISC III). Second generation Deaf children scored an average I.Q mean of 107

versus 100 for Hearing children in PIQ tests. Sisco and Anderson (1980) explained this higher score as an inherited I.Q (see also Kusche, Greenberg and Garfield, 1983). Sisco and Anderson (ibid) argue that Deaf parents are better prepared to meet their D/HOH child's needs and the fact that visuo-spatial skills are boosted by learning sign language.

These results have been replicated by Craig and Gordon (1998) and Kusche, Greenberg and Garfield (1983). Paquin (1992) tested second generation D/HOH children and found that they had an average PIQ mean of 114.5 which they argue shows a high genetic inheritance. Paquin (ibid) argued that bright D/HOH people marrying or having children with other bright D/HOH people means that their D/HOH children display higher than average intelligence quotients. They called this "Assortative mating" (see also Braden, 1994, P101-103).

Problems abound around this theory: There are over 100 different types of genetic deafness which are both dominant and recessive (Boughman and Shaver, 1982). It is improbable that high I.Q could be linked to over 100 different types of Deafness but it may not be ruled out until researchers test Hearing children of D/HOH parents and make comparisons with second generation D/HOH children.

Braden (1987) looked for another possible explanation for the high average I.Q amongst second-generation Deaf children. He tested D/HOH individuals using reaction time and manual movement time along with cognitive testing on the Raven Progressive Matrices (see also, Raven, Raven, & Court, 1998a, 2000). He reported that second generation Deaf children had the quickest reaction times and Deaf children of Hearing parents were quicker than hearing children on reaction time tasks. On cognitive tasks, second generation Deaf children fared better than Hearing

children on the Ravens Matrices. Braden argued that factors related to language and early environment rather than genetic background can explain these findings. Krouse and Braden (2011) have argued that the use of performance items on tests of PIQ have advantaged D/HOH populations and the depression of scores reported in the WISC-IV may indicate that a more average norm approaching 100 may be a more accurate reflection of second generation Deaf children's performances.

Furth (2006) investigated the linkage between scholastic ability ratings and performance on two concept formation tasks and one memory task. A sample of 187 D/HOH children aged 6 ½ to 12 ½ representing the entire population of a 136 pupil deaf school and 51 pupils from two day schools. The school principal and class teacher rated the students on ability (No standardised intelligence tests were used) and these ratings were compared to task performances. The results showed that there is a significant relationship between performance on the learning tasks and scholastic ability ratings. They suggested that psychologists should look at the "possibility of using non-verbal learning tasks for assessing the cognitive ability of D/HOH children and predicting academic performance" (Furth, 2006, p70) which suggests that tests of non-verbal ability can correspond to academic outcomes.

However, language development, cognitive growth and academic performance are rarely independent. La Sasso (1999) specifically warned of differences in the test-taking strategies and skills of D/HOH and hearing children related to reading strategies, test format and the kind of information accessed (see also Kritzer, 2009,b, for similar results in terms of mathematical ability in D/HOH children).

Traxler, (2000), reported that less than ½ of the eighteen year old D/HOH students leaving high school have reached fifth grade (10-11 years old) level in reading and

writing skills and over 30% leave school functionally illiterate. Clearly such high numbers of functionally illiterate students cannot be linked to a normally distributed intelligence curve amongst D/HOH populations. There must be other aspects of environmental deprivations at play to explain these very low academic scores among D/HOH school populations. The next chapter will identify and explain other factors that may explain why D/HOH individuals fare so poorly in the education system

Summary

Intelligence testing of D/HOH populations has been in existence since the very development of intelligence testing by Alfred Binet in France at the turn of the last century. Researchers have been fascinated by the concept of language and cognitive or intelligence development. It seemed natural at that time to wonder how a person who was born D/HOH could *think* without language. It was assumed that D/HOH people were incapable of reason and thus must be mentally deficient. Early intelligent testing seemed to prove this point. Results of language-based intelligence tests identified D/HOH populations that scored in the Mild General Learning Difficulty range (an I.Q. of 50-69 when an Average I.Q. is between 90 and 109). It was assumed that D/HOH individuals would not be able to think and reason as well as their Hearing peers. Heomann (1991) stated that it took over forty years for this assumption to be refuted. Braden's (1994) seminal book "Deafness Deprivation and I.Q." showed that I.Q. tests have reported higher I.Q. scores in the D/HOH population in direct correlation to the date of the test: the older the test the more likely the test would report lower D/HOH I.Q. scores.

Braden completed a meta-analysis of over 324 independent sample studies with 171,517 participants and reported several findings that have influenced this research:

- Intelligence tests on D/HOH populations produce much lower mean I.Q scores when Verbal Comprehension subtests are used.
- Intelligence tests that use Performance items are likely to favour second generation D/HOH individuals. This is due to their use of visual tracking, visual perception and manual dexterity and visual acuity as a result of being exposed to sign language from early infancy.
- The higher than Average Performance I. Q scores are not due to heredity or genetic inheritance.
- I.Q tests that use only Performance I.Q (PIQ-Fluid Reasoning plus Processing Speed) are likely to report a mean I.Q for D/HOH at the same level or slightly higher of a hearing population. New research on the WISC-IV indicates that the new I.Q. index called Perceptual Reasoning reports an average mean for D/HOH at a lower level than that of the hearing population on which the WISC-IV was normed (Krouse and Braden, 2011). The main reason for this is that PIQ from previous Wechsler tests incorporated Processing Speed which advantages D/HOH participants (Krouse and Braden 2011)
- Thus, when Performance items are removed from intelligence tests, D/HOH populations produce lower than Average mean I.Q scores (100) which have not been explained to date.
- Second generation D/HOH individuals surpass D/HOH children of Hearing parents which is explained as a language acquisition advantage. Hearing

parents rarely exposed their D/HOH child to fluid and expansive sign language.

The following chapter will address other issues around D/HOH individuals which may impact on how their intelligence develops and attempts to answer the reason for the lower mean scores produced in intelligence tests among the D/HOH population.

Chapter Three

3.1 Introduction

This chapter will focus on the key areas and topics of research in the D/HOH world which are linked to cognitive/intelligence development and testing. In the last chapter we noted how, initially, it was thought that D/HOH individuals were lacking in the ability to think and reason. In ancient Greece, Socrates noted that deaf people must be able to think as they can communicate through sign (Eriksson, 1998). Over time, other questions developed such as “Are D/HOH people able to learn?” “Do they learn differently than the Hearing population?”, “Do D/HOH people think differently than Hearing people?” In more modern times and with the onset of technology such as magnetic resonance imaging (MRI) and computerised axial tomography (CAT) scans, a current question might be “Is D/HOH people’s brain functioning different than Hearing people’s brain functioning?”. All of these questions will be addressed in this chapter.

Questions that have been previously researched fall into eight key areas:

1. Do D/HOH individuals *think* differently to Hearing Individuals?
2. How do D/HOH individuals acquire language?
3. Does cochlear implantation solve the problem of Deafness?
4. Is sign language usage the same as “speaking”-only in sign?
5. Can the use of sign language interpreters “level the playing field?”
6. Are D/HOH individuals different than Hearing individuals in how their brain develops?
7. Does using sign language impact on memory capacity?
8. How do D/HOH individuals think about how Deafhood affects them?

By looking at an overview of the research to date it is hoped that some inferences can be made with regard to whether cognitive/intelligence testing is appropriate using sign language or whether it is appropriate to test a D/HOH individual's ability in a way that is not reliant on language. It is hoped that the research review can identify some methodologies which will guide the present research.

3.2. Do Deaf and hard of Hearing individuals *Think* differently than hearing individuals?

Theory of Mind.

To develop our thought patterns and become cognitively aware, it is commonly held that one must develop a Theory of Mind (ToM). That is, the ability to think about something in the abstract, the “awareness of how mental states such as memories, beliefs, desires and intentions govern the behaviour of the self and others “ (Peterson, Willman and Liu, 2005, p502).

ToM is the ability to develop an understanding that our perceptions and thoughts do not always reflect the world as we know it. Other people see the same world and think about it differently than we do. In order to achieve the understanding of other people's behaviour a child needs to learn that other people have desires and beliefs that are different from his or her own and that these desires and beliefs can explain the behaviour of others (Wellman and Gelman, 1992). Other definitions of ToM include “The ability to attribute thoughts beliefs and feelings to ourselves and to other people and to our understanding that actions are governed by these thoughts beliefs and feelings” (Baron-Cohen, Tager-Flusberg and Cohen, 1993)

As early as 1973, Odom, Blanton and Laukhuf noted a delayed ToM ability in D/HOH populations. Courtin (2000) also noted that D/HOH individuals were significantly delayed in the False Belief Task commonly used for ToM test (the Sally Ann Task). A child is told a story of Sally Ann (a doll) who places an object (for example, a ball) in a storage place and then leaves the room. A different doll moves the object to another storage place and then the child is asked “where will Sally Ann look for her ball?” A child with a ToM will know that Sally Ann will look for her ball where she placed it even though they know it is not there. A child who has not developed a ToM will think that Sally will look for the ball where it actually is i.e. where the other doll placed it.

Wellman and Liu (2004) argued that the real ToM litmus test is the child’s ability to infer that someone else believes that something is true when they themselves know it to be wrong. Results show a delay in mastery of this skill for D/HOH children of hearing parents which is often put down to exposure or restriction of dialogue (Peterson and Siegal, 1999). Results consistently show that second generation D/HOH children are equal to or better than Hearing children in ToM tests (Courtin, 2000, Moeller and Schick, 2006)

A question might be phrased thus: “Does late language acquisition hinder a D/HOH child’s thought process through poor comprehension levels or even poor language ability?” If one does not understand what is being asked then a ToM task can be difficult, if not impossible to work out. The question of ToM development is a key area of research relating to D/HOH individuals as it identifies several key aspects of Deafness: can one *think* without language?

Moeller and Schlick (2006) duplicated Courtin's research and also noted that second generation D/HOH children were on a par in their development of ToM with their Hearing peers. They concluded that their findings supported the view that language delay is causally related to ToM delay. Peterson and Siegal (1995, 1997, and 1999) also investigated the performances of D/HOH children on theory of mind tasks (the Sally Ann task). Previous research had found that a typical four year old Hearing child can perform this task. They found that only 35% of D/HOH children the same age could perform this task. The success was unrelated to the D/HOH child's age or non-verbal I.Q (assessed using the Raven's Matrices). They also compared D/HOH children's performances to autistic children and found comparable results. This led Peterson and Siegal to suggest that language development is the key factor in ToM development (although the D/HOH children in the test were not measured for language).

Russell, Hosie, Gray, Scott, Hunter, Banks and Macaulay (1988) claim that children who are D/HOH do not develop ToM a full ten years later than hearing children. The net result of these studies suggest that language development plays a key role in children's ability to understand the behaviour of others.

In an attempt to avoid the issue of late language acquisition, Marschark and Everhart (1999) used a different approach than the traditional Sally Ann task by asking D/HOH children to participate in a "Twenty Questions" game. They noted that there was a lack of metacognitive awareness when testing the ToM of D/HOH children. They noted that D/HOH children used less "constraint" or category based questions. It took these children much longer to get a correct answer as they tended not to use categorical questions such as "is it a person or an object?" and "Is it a man or a woman?" In summary, delayed or under-developed language acquisition had an

impact on the D/HOH participant's ability to get the answer in the Twenty Questions game.

Schlick, de Villiers, Hoffmeister and de Villiers (2007) reported that vocabulary knowledge had a positive relationship with ToM performance. They suggested that one of the factors that may influence the delayed ToM development of D/HOH children of Hearing parents is the notion that they are not exposed to social interactions with other children and family members due to a lack of awareness that the child is indeed D/HOH. The delay in diagnosis of D/HOH is becoming much shorter due to Newborn Infant Screening but the reality is that most research completed in the first decade of this century was undertaken with children with a late diagnosis. Waxman and Spencer (1997) noted the lack of communication between hearing parents and their D/HOH children. They reported that the parents of D/HOH children have poor levels of communication and play with their children which impacted on their imaginative play and social interaction. The delay of language development has a crucial impact on the cognitive development of D/HOH. The consequent delay in social interaction, ToM and memory affects cognitive development (Marschark, Green, Hindmarsh and Walker, 2000).

Mayberry (2002, p71) states that "Children who are born deaf clearly miss a great deal- we must ask whether complex and logical thought can develop in the absence of spoken language". Can the child develop "inner thought" or Working Memory without the ability to hear" (ibid, p71). This question has been addressed by Marschark (2003, p464) who states: "There is no evidence that hearing loss diminishes cognitive abilities in general". Clearly D/HOH children produce delayed cognitive development as a result of environmental factors such as delayed language acquisition. Marschark points out that "this does not mean that we can

assume that deaf people think learn or behave exactly like their hearing peers” (ibid). The evidence suggests that TOM development amongst D/HOH children may be delayed but they are as capable of developing the skill as their hearing peers. As Marschark has often pointed out: D/HOH are not just “Deaf” children who cannot hear (Marschark, 2010). This relates directly to the research question of using a language laden intelligence tests with D/HOH children. It seems that the research available to date would suggest that it would not be appropriate to use tests that have a heavy language demand. Hauser et al (2008) have argued that this is the challenge for researchers in the field: we must identify the differences between Hearing and D/HOH individuals in how they process information, i.e. their cognitive differences so that we can offer the best interventions possible.

3.3. How do D/HOH Individuals Acquire Language?

Today, as a century ago, many D/HOH children show important deficits in their language development. The most common aspects of D/HOH child’s development includes; slow and incomplete acquisition of oral language (for review see Lepot-Froment and Clerebaut 1996, Santana, Torres and Garcia, 2003) and thereafter, poor reading levels. As Conrad (1979, pxi) stated “The education of children born D/HOH is essentially a war against cognitive poverty”.

Meadow (1968, p28) commented that the basic impoverishment of hearing impairment is not lack of hearing but lack of language. The important task for all children is the learning of a lexicon, morphology, syntax and semantics of language, not necessarily the act of speaking. Even children with a moderate hearing loss (56-70dB) can display a one year delay in language development by age five while children with a severe hearing loss (71-90dB) show a three year lag in vocabulary

development (Davis, Elfenbein, Chum and Bentler, 1986). Bishop (1983) showed that D/HOH children aged 8-12 (n=71) showed an average comprehension of spoken vocabulary to be less than would be expected of an average four year old Hearing child. Moeller, Osberger and Eccarius, (1986) reported that there is a distinct lack of lexical development after the ages of 12-13 in D/HOH children. They also showed a severe delay in vocabulary comprehension in D/HOH children from the age of 4 to 20 years (Using a sample of 150 D/HOH children aged 4-20 years old). Edward and Croker (2008) have argued that hearing impairment itself does not cause cognitive impairment but reduced language and auditory input at an early stage of development which may lead to differences in the ability to comprehend and use language effectively.

Research by Lederberg, Prezbindowski and Spencer (2000) found that overall vocabulary size (not age) predicted D/HOH children's word learning strategies and suggested that hearing impairment does not affect the cognitive process of word learning.

Quigley and King (1980) in a detailed investigation into D/HOH children's use of syntax (n=400) found that the more severe the hearing loss, the more severe was the difficulties with proper syntax production. This clearly associated hearing impairment with delayed language development. They argued that the difficulty D/HOH children face is like, or similar, to second language (L2) learners. The research questioned the use of language-based tests that essentially, tested a second language. This question links directly with the research question of the efficacy of using sign language (L1) to test cognitive ability (intelligence) through a second-language medium (L2).

Everhart (1998) showed that D/HOH children learnt one new word per month at the age of 30-48 months compared to Hearing children who were learning 6—120 words. Language delays were reported consistently across different modes and types of early intervention whether it be Total Communication, signing or oralism. The use of sign language does not eradicate or remove the difficulties associated with hearing loss and early language acquisition.

Indeed, Mayberry and Lock (2003) interviewed 24 D/HOH 7-15 year olds and reported that one third could not communicate with any member of their families as none of their hearing family members knew how to use sign language. They commented on the fact that sign language communication was restricted to what happened during class time and that it was obvious that D/HOH children were not exposed to their primary language (L1) for the majority of the day. Moeller and Schick (2006) noted that when parents learned sign language and used Total Communication, there was considerably more success for D/HOH children in learning and academic outcomes.

Lederberg and Everhart (1998) reported that parents using sign with their D/HOH children did not prevent their children from developing speech. They highlighted the necessity of language acquisition as a vital factor in the development of the D/HOH regardless of the mode of communication. Mayberry and Nicoladis (2000) also reported that Hearing parents of D/HOH children use more basic single iconic gestures for complex ideas thus reducing the development of more complex language. Mayberry (2002) had previously suggested that the postponement of first language (L1) acquisition to ages beyond early childhood has permanent deleterious effects on language comprehension.

Moeller, Tomblin, Yoshinaga-Itano, McDonald-Connor and Jerger, (2007) have reported that even a mild or moderate hearing loss can severely impact on the language development of children. Without communication reciprocity, D/HOH infants and toddlers do not learn to associate words with emotions and consequently are not able to express their needs and wants (Meadow-Oleas, Dyssegaard and Smith-Gray, 2004). They begin to externalise their emotions and thoughts through behaviours (Garcia and Turk, 2007). These behaviours can become more severe than their hearing peers and has been known to produce poorer mental health (Wallis, Musselman and Mackey, 2004). It is clear that language acquisition at a developmental appropriate age is essential for cognitive, emotional, language and social communication skills.

Mayberry, Lock and Kazmi (2002) investigated second language learners compared to D/HOH individuals (D/HOH versus non-English speaking European immigrants) and reported that there was no difference in language ability, except for late first language learners. They suggest that “D/HOH people who, for whatever reason, are not exposed to accessible language during the early years (in any form: sign, spoken or Total Communication) consequently suffer from two permanent handicaps: they cannot hear sound and they do not readily comprehend any language in any mode. The second (comprehension) is completely preventable” (Mayberry, Lock and Kazmi, 2002, p16).

Robert Winston has aptly described the concept of first language (L1) acquisition in the following quote: “We *develop* our first language and *learn* other languages” (Winston, 2003, p270). He argues that one does not need to hear to develop language:

“Although there is a direct link between the auditory cortex and the language region of the left hemisphere you do not need to hear to develop language. MRI studies of deaf children born to deaf parents reveal a language region just as developed as hearing children. Moreover non-deaf children born to deaf parents never attain the same degree of fluency in sign language as their deaf siblings which is similar to second language learners” (Winston, 2003, p270)

Individuals who speak two languages can recall more words from their native language and have quicker comprehension levels in their first language (Novack and Bonvillain, 1996 and Hamilton and Holtzman, 1989). Spencer and Meadow-Orlans (1996) investigated the length of utterance either in sign or in oral language in a sample of thirty two-year old children with second generation D/HOH, D/HOH children of Hearing parents and Hearing children of Hearing parents. They noted that D/HOH children of Hearing parents produced the lowest amount of utterances in symbolic play. Second generation D/HOH children were equal to Hearing children of Hearing parents in the amount and length of utterances during symbolic play. This again, suggests that early language acquisition is a key factor in a D/HOH child's development.

Peterson and Siegal (1999) found that second generation D/HOH children with cochlear implants experienced early access to language therefore they were not communicatively impoverished. One main difficulty with the issue of early language acquisition is that Deaf children of Hearing parents outnumber second generation Deaf children by a ratio of 9:1 (Marschark and Spencer, 2009). It is clear that D/HOH children of Hearing parents are in the majority of the D/HOH population and have issues with early language acquisition. However, there are also many difficulties that second generation Deaf children experience when interacting with individuals who are not fluent in sign i.e. hearing siblings and peers in school (Anita and Levine, 2001). This lack of enriched language exchange and interaction can and does stymie

language development in second generation Deaf children growing up. This fact is particularly germane as in the U.K as much as 75% of deaf children attend mainstream schools (Royal National Institute for Deaf people, 2014, <http://www.actiononhearingloss.org.uk/your-hearing/about-deafness-and-hearing-loss/statistics.aspx>).

Furth (1966, 1971) who completed a longitudinal review of D/HOH children compared to Hearing children on reasoning tasks, memory and perception, reported very little difference between the two groups on these tasks. Furth concluded that the vast majority of people born D/HOH, do not acquire functional language competence (Known as C.A.L.P: Cognitive Academic Linguistic Ability). Vernon (1967c) also concurs that D/HOH children are often deprived of language throughout childhood and perform poorly on tests of language and reading skills. Borgna, Convertino, Marschark, Morrison and Rizzolo (2010) have also shown that issues arise at levels for literacy which go beyond pure reading skills. They found that while some D/HOH students read as well as hearing aged peers, most lag behind in the reading subdomains of vocabulary, syntax, inferencing and comprehension (see also Brown and Brewer 1996, Traxler, 2000, Trezek, Wang and Paul, 2009, and Marschark, 2009). Offering consistent rich language input by parents whether in sign or in spoken language seems to be the key factor in establishing reading proficiency in D/HOH students (Harris and Beech 1998).

Spencer Meadow-Orlans (1996) found no differences of language development between D/HOH children and Hearing children at 9 months but by 12 months the gap started to appear as Hearing children had more language exchanges than D/HOH children. By 18 months D/HOH children of hearing parents were significantly delayed in their language development when compared to either second generation

D/HOH children or Hearing children of Hearing parents (Ibid, p93, see also Jacobs, (1989) and Schien and Delk (1974)).

Goldin-Meadow and Mayberry (2000) have stated that deaf children learn American Sign Language at the same rate as hearing children acquire spoken language. They argue that the main challenge is accessibility to sufficient language input at the right age. Scovel (2000) has also reported that languages are best learned early in life. A late diagnosis of deafness is a challenge for parents and D/HOH children. Once they pass what is termed the Critical Period (Hurlford, 1991), language acquisition is never as fluid and natural as a typically developing Hearing child of Hearing parents. Moeller (2000), Yoshinaga-Itano and Apuzzo (1998) have reported that the delayed identification of D/HOH infants is related to reduced language and communication fluency. Parental reactions such as distress and denial can reduce the speed at which intervention services are initiated after identification of deafness (Moeller, 2000, p336).

Once the critical stage of language acquisition has been passed or delayed, consequent difficulties arise around comprehension and fluency.

The lack of complex early babbling by D/HOH children means that, at the age when parents and siblings first start responding to their “communication attempts”, D/HOH babies are already at a disadvantage relative to their hearing peers (Marschark, 2001, p14). It may be more than a year, on average, before those children are recognised as D/HOH and some form of intervention begins. With the introduction of the Newborn Hearing Screening Test in many countries, this significant delay has been reduced to a number of months, if not weeks.

Hearing parents who have received a diagnosis are still challenged to develop early communication and to develop a skill in sign language. However, Vaccari and Marschark (1997) have highlighted the poor signing skills of Hearing parents and the inability to develop sophisticated and complex bi-directional communication. Another challenge to Hearing parents is to develop a distinction between communicating words and symbols *and ensuring that comprehension is acquired*. A child's learning how to make signs, as in learning how to say words, may be separate from understanding the meanings of those words or how they might be used in a sentence (Levy, 1997).

3.4. Does cochlear implantation solve the problem of Deafness?

Earlier in this chapter, it was shown that late language acquisition and the delay that can occur with late diagnosis of hearing impairment can have detrimental effects on a D/HOH child's development and academic outcomes. In this section, the effect of cochlear implantation will be outlined in terms of the effect it has had on the D/HOH population.

Cochlear implantation (C.I.) is not a recent development: the first implant device was approved by the FDA in 1980. From this time, the number of D/HOH children with C.I. have increased throughout the world (Hyde and Power, 2006). It is worth noting that fundamental opposition to the use of C.I. still remains within the Deaf community (Swinbourne, 2011, and Gale, 2011). Recently there has been a move away from polarised views and a focus on what is in the best interests of the child (Moeller, and Schick, 2006, and Seaver, 2009). Big D communities can often believe that their very existence as a distinct community is challenged by the use of C.I.

Cochlear implantation promotes acquisition of speaking and listening skills (Kirk et al, 2002), improved interactions with Hearing peers (Bat-Chavea and Deignan, 2001, and Bat Chava, Martin and Kosciw, 2005), improved quality of life and social interactions and academic performance (Schorr, Roth and Fox 2009). Not every child is automatically a candidate for a cochlear implant: Blamey (2003) notes that cochlear implants are usually only given to children with moderate to severe hearing loss *with* a hearing aid. In Ireland there was a policy of only giving a child one cochlear implant and a long campaign was fought to make bi-lateral implantation the norm (<http://www.specialneedsparents.ie/campaigns/provision-of-bilateral-implants-for-irish-deaf-children>).

It is not a simple choice between sign language usage and oralism: cochlear implants users continue to find spoken language challenging (Moore, 2009) and several studies have shown that sign language acquisition does not negatively impact on C.I users (Connor, Hieber, Arts and Zwolan, 2000 and Preisler, Tvingstedt and Ahlstrom, 2005). There is evidence that using sign language alongside C.I can result in significantly greater gains in receptive spoken vocabulary and superior scores in expressive vocabulary compared to those who either sign only or who use oralism (Connor et al, 2000).

It is clear that a cochlear implantation will neither “Make D/HOH children into Hearing children nor leave D/HOH children stranded between the Deaf and Hearing worlds” (Marschark, 2014, p206).

Marschark, in his review of the way D/HOH are educated in Ireland recommends that parents and family are offered Irish sign Language as soon as a diagnosis of hearing impairment is confirmed. He reports that evidence suggests that learning sign

language will not harm the child's oral language when it develops. He states that a mixture of educational settings are better: that children can move into and out of alternate settings and discover those in which they are most likely to thrive. This can be an issue in Ireland however as moving from a second level mainstream school into a special school setting can be very challenging for a child who has limited sign and who identifies him/herself with the Hearing world. To move into a special school at the age of 13 or 14 can be quite a challenge when one's peers use sign language and classes are delivered through ISL and the D/HOH child may not be as fluent in sign language as others in the class.

Research by the British Association of Teachers of the Deaf (2012, p8) reports that "Although cochlear implants are able to provide good levels of speech recognition in quiet situations, they are generally unable to provide good perception of voice pitch information such as stress and intonation" (which plays a significant role in speech and language development and especially comprehension).

Knoors and Marschark (2012) have suggested that with the recent growth in Universal Newborn Hearing screening and technological advances such as digital hearing aids/cochlear implants, more D/HOH children than ever before have the potential for acquiring spoken language. They argue that earlier diagnosis and intervention have positive effects on D/HOH children's language development, both signed and spoken, even if they lag somewhat behind hearing peers (Moeller, 2000, Yoshinaga-Itano and Sedey, 2000).

Knoors and Marschark state that "Whereas only a few years ago, implantation prior to age 3 was considered "early" it is now common at about 1 year of age, and three years is considered relatively late" (ibid, p233). The issue of language acquisition

and delay may, in this generation, be ameliorated due to early identification and the use of cochlear implants.

Oghalai, Caudle, Bentley, Abaya, Lin, Baker, Emery, Bortfeld and Winzelberg, (2012) assessed the effects of cochlear implants in D/HOH children with and without developmental delays. They reported a significant increase in intelligence and adaptive behaviour for the children without developmental delay who received a cochlear implant. It makes sense that, in the light of what we know about delayed language acquisition and cognitive development, more and more children are being diagnosed within weeks, if not months, of being born and once that have been identified they are assessed for C.I which means that they will, more than likely, hear and speak whether they are taught sign language as a parallel support or not. The children in this study were all diagnosed quite late and spend at least two years without proper access to language of any kind. Thankfully this is unlikely to happen again in an Irish context. It is understandable that the Big D community sees C.I as a threat as less and less children will be sign language users as they begin to hear and speak.

3.5. Is sign language usage the same as “speaking”-only in sign?

Knoors and Marc Marschark (2012, p292) suggest that the idea of continuing to offer sign language to early diagnosed D/HOH children and their parents is not a political or philosophical one but one of providing D/HOH children with the best possible opportunities for educational and personal success. Children with access to fluent communication and language will develop in a way that will not impair their cognitive growth and language acquisition.

Largely through informal means, children acquire basic interpersonal communication skills (BICS) whereas schooling helps to develop cognitive academic language proficiency (CALP). For children who grow up bilingual, language skills can be imagined as a double iceberg. BICS in both first and second language are found above the waterline, whereas CALP skills are under the waterline are much larger but less obvious (Mayer and Akamatsu, 2011). Total communication is a way of utilising all communicative skills available such as lip reading, sign language, speaking and using signed English. It is a pragmatic approach to communication and the advice that is given to parents can be described as “Do what works”.

The key question of where to send a D/HOH child to school remains a serious challenge to parents. If children are sent to specialist schools, the child will develop sign language at a rate far beyond their parent’s ability to become fluent in sign language which will become their L1. The level of exposure to sign language is often four to six hours a day in a room where signing was the primary means of communication (Marschark, 2001, p21). Hearing parents will never reach the levels of competency as they will hardly sign for this amount of time and it will be an L2 for them. Total communication in school settings gives the D/HOH child a method of finding out what works for them. Marschark (2001) has shown that C.I D/HOH children who use sign language generally stop using it when they are “switched on”. This means that their cochlear implant is literally switched on and they can begin to hear.

Leiderberg and Spencer (2001, p3) reported that the majority of D/HOH children “are relatively deprived of linguistic input and develop language in a less rich linguistic environment than hearing children or second generation D/HOH children. For example, students of ASL are initially unable to tell the difference between “I am

always sick” and “I am frequently sick” They gradually lose the ability to discriminate and produce language elements with which they have no experience (Marschark, 2001).

3.5.2. Sign Language Proficiency and the Use of Interpreters

One of the challenges for researchers working with D/HOH individuals is the issue of language proficiency in both oral and signed language. The difficulty of assessing ability in ToM tasks as well as administering intelligence tests is that the researcher is hindered by the understanding of the language proficiency in the child.

Most second generation D/HOH children can communicate effectively in sign language but researchers and educationalists do not have standardised tests to assess their level of language proficiency. There are no standardised sign language tests used by psychologists or speech and language therapists for language ability in Ireland (private communication with a speech and language therapist that works in the Deaf schools in Dublin). This is the same in other countries: there is no standardised test for sign language in France or the United States. Therefore, in many of the research papers discussed above, the ability/proficiency in spoken or signed language was assessed on the opinions of the child’s teacher or not at all. While Hearing people can learn ISL and take exams to certify a level of proficiency, there is no equivalent for D/HOH individuals.

Marschark, Leigh, Sapere, Burnham, Convertino, Stinson, Knoors, Vervloed and Noble (2006) have shown that even when D/HOH students have the benefit of sign language interpreters during lectures, the actual content understood by these students is quite low. Even for third level students, the poor language development in the early years has a profound long term effect. Emmorey, Bellugi, Frederici and

Horn (1995) have argued that sign language proficiency is at best a second language (L2) acquisition for D/HOH children of hearing parents and, as a result, they never master the subtleties of first language (L1) interaction. They compare the skills of Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP), stating that once a D/HOH child misses the key development stage of language acquisition they may never acquire the language skills to excel academically.

Marschark, Leigh et al (2006) tested various means of supporting D/HOH students at Gallaudet University in the United States (the first University for D/HOH Students) during lectures. They used sign language interpreters, Real Time Text and Speech to Text for students and then tested levels of comprehension. Real time text (C-Print) was reported as the best support for D/HOH students, yielding the best performance on tasks of comprehension and knowledge. However, in all conditions of support, D/HOH students were significantly below that of Hearing peers who listened and saw lectures without any support. This study is supported by a series of parallel research investigations into D/HOH students' achievement in second and third level educational placements. There is a history of D/HOH students lagging behind hearing peers in a variety of educational domains and across placement settings (Karchmer and Mitchell, 2003, Kidd, Madsen and Lamb, 1993, Stinson and Lkuwin, 2003, and Traxler 2000).

It has been reported that D/HOH students report understanding more from Real Time captioning than interpreting (Stinson et al, 1988) but they also think that they understand more sign language than they actually do (Marschark Sapere, Convertino, Seewagen, & Maltzen (2004). This is vitally important as many Hearing

organisations think that, by providing interpreters, D/HOH sign users are accommodated for in terms of being able to access what is spoken.

In an extensive review of the literature Marschark, Convertino and LaRock (2006) found that D/HOH students were less likely than hearing peers to use sequential processing skills across a variety of reading tasks. Richardson, MacLeod-Gallinger, McKee and Long (2000) have shown that D/HOH students have more difficulties integrating or synthesising information across texts.

Despite years of research into teaching methodologies with D/HOH students we are not fully sure about best teaching methodologies and how D/HOH children learn (Knoors, 2005, Marschark Convertino and LaRock, 2006). Despite different methodologies around translation and language support, there is a lack of understanding about the effectiveness of D/HOH students learning through interpreting (Marschark, Sapere, Convertino and Seewagen, 2005).

One of the difficulties associated with the inclusion of D/HOH in mainstream classes is the simple fact that language support, sign language support and translation methodologies fail to adequately address the delay in early language acquisition of D/HOH children. In the United States, out of 40,000 D/HOH children, only 27% attend a specialist Deaf school or centre (Gallaudet Research Institute, 2003 Annual Survey of Deaf and HOH children and Youth.) This suggests that a vast amount of D/HOH may not be adequately accessing the curriculum thus further compounding the issue of low literacy levels amongst the D/HOH population.

Karchmer and Mitchell (2003) report that in the United States, more than 75% of D/HOH students in primary schools are now enrolled in regular education classrooms. In Ireland, D/HOH children attending mainstream classes may have

“access” to a special needs assistant but it is rare that the special needs assistant has ISL or Total communication training. In the main, teachers wear a microphone or use a Loop system which is connected to a child’s hearing aid (Personal communication with NCSE senior manager in May 2015). Given what we now know about how D/HOH students struggle with comprehension levels and, in general, delayed language acquisition, this may be related to the historically low literacy levels in the D/HOH population. Research has also shown that the use of interpreters does not necessarily solve all communication problems and comprehension may still be an issue for D/HOH individuals. The next section will address this issue.

3.6. Can the Use of Sign Language Interpreters “Level the playing field?”

Jacobs (1977) was one of the first researchers who showed that D/HOH college students learned significantly less from classroom instruction using interpreters than their Hearing peers. He identified the difficulties of using sign language as one of the key aspects of the assessment of D/HOH students. Previous beliefs that the compensation of using sign language levelled the academic playing field were challenged and dismissed by Jacobs’s research. The notion that one can use sign language interpreters to cognitively assess D/HOH students is linked directly to the research question of this thesis.

Marschark, Sapere, Convertino, Seewagen and Maltzan (2004) also investigated the use of sign language to assess D/HOH students’ abilities replicating Jacob’s research and produced similar findings. They used a comparison grouping in 2005 (Marschark, Sapere, Convertino and Seewagen, 2005) when replicating Jacobs

findings. That stated that using sign language interpreters is not enough to bridge the gap created by a lack of early language acquisition.

In a very interesting piece of research, Marschark et al (2005) tested comprehension levels of trained bi-lingual interpreters (n=20). The interpreters watched interpreted lectures (with no audio) and then received a multiple choice assessment of learning. The interpreters almost scored 93% while D/HOH students watching the same lecture averaged scores at 53% in terms of knowledge content. This highlights the fact that having lectures (or indeed intelligence tests) interpreted using sign language is not sufficient for comprehension and understanding to occur for D/HOH students.

In a similarly interesting piece of research, Marschark, Convertino, Macias, Monikowski, Sapere and Seewagen (2007) used a trivial pursuit game to test comprehension and knowledge amongst D/HOH third level students. When using an interpreter to sign questions, D/HOH students achieved a success rate of 63% whereas oral questioning where students used lip reading produced scores of 44%. When mixed ASL and spoken questions were asked (i.e. Total Communication), students achieved a success rate of just 46%. This implies that D/HOH students have less than full comprehension of “through the air” communication even when it is simple and direct. Marschark, Convertino et al (2006) have also argued that it could be nothing to do with comprehension skills nor interpreting per se. All available evidence points to differences in the way D/HOH students learn and the fact that lectures structured by hearing teachers are pitched at hearing students. This could also be true for the administration of intelligence tests through sign language. If the students are similar to the Marschark, Convertino et al (2006) participants, it is highly likely that students could miss out on a least forty percent of the material translated including instructions and questions.

In a follow up study, Marschark et al. (2006) tested various methodologies in a second level classroom where D/HOH students received instruction. They reported that using print materials and visual displays simultaneously in integrated classrooms may deny D/HOH student's access to information available to Hearing peers. Similarly, they noted that using an interpreter and text support potentially forces the D/HOH student to focus on one or the other mode of information (see also Napier and Barker, 2004 for a similar third level experience).

The different sources of information will be out of synchrony as students are unlikely to be able to predict which source is important at any given time. In this experiment (Marschark, Convertino, Macias, Monikowski, Sapere and Seewagen, 2006) there were three support services: Interpreting, C-Print or both. There was quite a large sample (N=95 with a comparison group of 32 Hearing students and the hearing thresholds among the 79 ranged from 35-120dB with a mean of 100dB loss). The goal was to test the best outcome for learning. There were no significant side effects for gender, type of lecture or hearing levels. Marschark et al (ibid) reported that, in terms of accessing a curriculum, in general, Hearing students come into the lecture with more knowledge than their D/HOH peers. They reported that Hearing students gained significantly more information (>30%) even when prior knowledge was controlled for. Students who used C-print scored significantly higher than using interpreters. When using both C print and interpreters simultaneously, students reported difficulties in deciding which one to attend to. In terms of actual content knowledge, students who used the C-Print solely produced the highest scores. Interestingly, D/HOH students produced lower scores on content knowledge when compared to their hearing classmates. Therefore, it can be concluded that the use of

interpreters did not aid or support the D/HOH students on a par with their Hearing peers.

This difficulty was experienced during the present research. Students had to focus on the interpreter and the tester (researcher) when participating in the cognitive testing. Students watching the interpreter had to focus on what was being signed while at the same time working out what they were being asked thus opening up a potential for confusion. They also had to look at the interpreter's face for other communicative cues.

In a similar piece of research using three conditions, C-Print, CART and Signing, Marschark, Convertino et al (2006) used C Print which essentially produces key concepts and summary notes as well as CART (an essentially verbatim account of the lecture as it happens). They also offered students an opportunity to receive sign language interpreting during the lecture.

Notes produced from C-print are significantly less in volume. C-print has ten lines on a monitor at any given time whereas CART has twenty-five lines. Marschark, Convertino et al (2006) tested knowledge of a given lecture directly after the lecture followed up by a test one week later.

Immediate first-test best knowledge performances was with students who used an interpreter and lowest scores were produced by students who used CART. Retesting one week later, students who produced the best results were those who used C-Print and worst results were noted from students who used the CART support. In Test condition 3, Australian sign language was used with secondary school Australian students. Three delivery modes were used: sign language by the teacher, signing plus Real Time text or Real Time text alone (Marschark, Convertino et al, 2006)

Students received all three modes of communication over three lessons. Students were tested for content knowledge straight after the class and one week later.

Students were not allowed to use notes or other aide de memoirs. Scores across all types of deliveries were quite low ranging from 30-40%. Unfortunately Hearing peers were not tested to offer a comparison group. This research does not agree with Stinson et al. (2006) that secondary school students learned more via Real Time text rather than sign language. It also involved direct instruction as opposed to interpreting thus not matching the same conditions. What is important to note is the low levels of comprehension of the lessons delivered to the D/HOH participants.

These results were followed by a fourth experiment which used interpreters rather than direct instruction. Marschark, Convertino et al (2006) used a daily news show for children shown on T.V which used captioning and interpreters, they tested one condition with captioning only and one condition with interpreters only. This research tested prior knowledge of the subject matter as well as familiarity with vocabulary used in the programme. Students were asked Y/N if they knew the meaning of a list of 19 words and reported an average of 12 words recognised. A key finding from the research was outlined in this statement: "Until recently we assumed that high quality sign language interpreting "levelled the playing field" but it does not. This is an assumption we now know to be incorrect" (Marschark et al 2005, p19).

In summary the researchers suggested that there was no inherent advantage or disadvantage in using C-Print or CART as opposed to using interpreters. There are many aspects of this research that can be challenged and commented upon. An initial comment would suggest that all four experiments were undertaken in "optimal" conditions which is rarely the norm in a school setting. Most schools in Ireland do not have the option of using C-Print, CART, Interpreters or teachers using sign

language. In mainstream classes there are no supports to students other than amplification. There was no allowance for a correlation between reading scores and performance as comprehension was tested. One of the methods used to support the class content was notes which were typed on a screen (C-Print and CART). This raises a question around the ability of students to actually read and comprehend the notes as they were being typed. Given that it is a well-accepted fact that D/HOH students struggle with literacy skills, it seems odd to present notes for them to read and understand. All across the four test conditions the performance was poor which means that we still have not arrived at the “tricky mix” that Knoors (2005) asked for. The idea of asking a simple yes/no answer to test the meaning of words is a very weak methodology. There was no way of knowing whether yes meant yes as this was not tested. A test of the meaning of these words should have been followed up with a question “what does it mean? Can you give me an example?” There is also a question to be raised around the use of such a different sample: some mainstream second-level students, some college students and some second level students in special schools. It is hardly measuring like-with-like. This is a recognised difficulty in carrying out research among a D/HOH cohort: gaining sufficient numbers and dealing with the issue of participants with other co-morbid conditions such as specific language impairment and specific learning difficulties as well as other genetic conditions.

Whether using sign language, Oralism, Total Communication or Signed Supported English, Marschark (1993) reported that D/HOH children had reduced comprehension and reading speed as well as a tendency to remember disconnected portions of text rather than the whole picture especially when the material is unfamiliar. He also reported that the gap in literacy skills actually increases through

the school years (Marschark, 1993, p35). It is quite clear that using interpreters does not level the playing field and that the use of text notes to support learning is fraught with difficulties around comprehension and literacy.

3.7. Neurological Findings, Are D/HOH individuals different than Hearing Individuals in how their brain develops?

One of the questions asked at the beginning of this chapter addressed the issue of whether D/HOH individuals think differently than their hearing peers. Advances in science have allowed us to ask similar questions around D/HOH brain structures. Do D/HOH individuals have different brain functioning than Hearing people? While this topic does not relate specifically to the intelligence testing of D/HOH it is worth having an understanding that being Deaf or having a hearing loss impacts on how one's brain develops. A fuller discussion, including referenced research is presented in Appendix N.

3.8. MEMORY: Does Using Sign Language Impact on Memory Capacity?

One of the issues around the capacity of D/HOH individuals for memory tasks is whether the use of sign language impacts or changes their cognitive processes. Marschark, Convertino et al (2007, p178) have suggested that it is a frequent research finding that sequential memory span for words or digits is decreased for D/HOH individuals as they use adapted auditory tests for Working Memory. They suggest that the use of sign language takes up more "space" than auditory memory requires hence lowering capacity. Lichtenstein (1998) noted that sign language articulation is slower than that of speech hence impacts on the ability of D/HOH individuals to remember long strings of conversations (See also Spencer and Delk, 1989). Therefore, how LONG it takes to sign as opposed to orally stating it can affect

Short Term Working Memory (Wilson and Emmorey, 2003). This issue has been illustrated in Word Length effect in memory (Baddeley, Thomson and Buchanan (1975) and in finger spelling memory tests for deaf children in Mayberry and Waters (1991). In a practical sense, it is worth noting that all sign language interpreters have to take breaks due to the effort it takes to sign exactly what is being spoken. If the same skill required the same amount of effort then there would not be a need for breaks: signing takes effort and time to convey the exact verbatim information and as a result can be quite tiring. Sign language can be brief and to the point in an effort to convey the essence of what needs to be communicated. Some examples are illustrated in the Results chapter which looks at back-translation.

Given that sign articulation is slower than that of speech, use of the former will of necessity extend the time required to produce the stimuli and or to produce the response (Lichtenstein 1998, Marchark, 2014).

Pisoni, Conway, Kronenberger, Horn, Karpicke and Henning (2008) have shown that children who have had cochlear implants later than the age of three have shorter Working Memory capacity than their hearing peers. This is not the case for second generation D/HOH children (Wilson, Bettger, Niculae and Klima, 1997). Carpenter, Just and Shell (1990) found that performance on the Ravens matrices was highly related to Working Memory. Second generation D/HOH children had likely a native language and hence developed mental language representations in addition to Working Memory. D/HOH children with Hearing parents wouldn't have this ability and hence tend to score on the low average range on Working Memory.

Wilson, Bettger Niculae and Klima (1997) reported that second generation D/HOH children significantly outperformed Hearing children on a test of visual working

memory (The Corsi blocks and Spatial Span subtests which were used in the present research). They noted a lack of strategies to help remember such as rehearsal: Rehearsal as a strategy tends not to be utilised by C.I implanted children or children who use Total communication as much as Hearing children and hence they perform several years behind their Hearing peers on Working Memory tasks.

Bebko and McKinnon (1990) found that the probability of using rehearsal was linked to the number of years a child used sign language. Hanson (1990) and Krakow and Hanson (1985) found the same gap for D/HOH adults in serial and ordered tests.

Hearing individuals tend to rehearse items that need to be remembered such as a phone number for example: Hearing individuals tend to “Chunk” numbers into groups to aid memory. A very good example of this would be remembering phone numbers: one tends to chunk or sort numbers into short bits (usually 3-4) and can then sing-song them to remember (Mathy and Fieldman, 2012). McEvoy, Marschark and Nelson (1999) have shown that D/HOH students are less likely to automatically activate high frequency exemplars in memory when they encounter a category name-lists of animals or colours (see also Marschark and Everhart 1999).

Mayberry and Waters (1991) have suggested that the later you acquire sign language the poorer your short term memory develops and also less likely D/HOH sign language users are to use rehearsal techniques (also Bebko and McKinnon, 1990)

There is reported evidence of shorter memory span for D/HOH children (Spencer and Delk, 1989). D/HOH children may not show a memory deficit but instead a cognitive difference between patterns of visual versus auditory processing. These

conditions were tested in the present research and are reported on in the Results chapter.

Pisoni, Conway, Kronenberger, Horn, Karpicke and Henning (2008) have shown that memory for digit span sequences is also shorter for children using cochlear implants than their hearing peers. Hall and Bavelier (2010) have argued that sequential memory tasks are inherently biased against D/HOH signers. They showed that visuospatial place memory is as good or better in D/HOH signers as hearing speakers concluding that memory preferences rather than capacity differences are at issue in such cases. This would suggest that in the present research, there may be a different level of performance for Digit-Span completed through sign on the WISC-IV^{U.K} and the Corsi Blocks on the Wechsler Nonverbal Scale of Ability as one could argue that the Digit Span scores could be impacted upon by the use of sign language whereas the Corsi blocks may work to a D/HOH child's strengths in visual memory.

Wilson, Bettger, Nicolae and Klima, (1997) showed that second generation D/HOH children using ASL had similar digit span memories to hearing peers for both forward and backwards digit span however, hearing children show considerable advantage over D/HOH children of hearing parents. This suggests yet again, that the early acquisition of language plays a key role in cognitive processes including Working Memory (see also Todman and Seedhouse (1994).

3.9. How do D/HOH individuals think about how Deafhood affects them?

Interviewing Deaf and Hard of Hearing individuals about their experiences.

Often missing from research in the D/HOH world is a D/HOH perspective: the vast majority of research methodologies tends to use quantitative methodologies to

gather data. The “Voice” of the child is often absent, literally as well as figuratively. However, some researchers have used qualitative methodologies to investigate the experiences of D/HOH children's experiences of mainstream education or the challenges involved in being a D/HOH child living in a hearing world. Research by Israelite, Ower and Goldstein (2002), Kent (2003), Brevick, (2005) and Sari, (2005) has addressed this by interviewing participants about their experiences of being D/HOH in the educational system or about their day to day lives and how hearing loss or deafness affects them on a personal level. Part of the present research interviewed participants about their ideas around being “clever” and “intelligent” and asked for personal examples of a lived experience.

A survey of research which involved gathering D/HOH individual's opinions on D/HOH issues was undertaken to investigate whether items arose which were particular to or challenging for the researchers. As the present research used a semi-structured interview schedule, the work of Nikolarazi and Hadjikakou (2006) was investigated in light of the fact that they used a semi-structured in-depth questionnaire which was developed for a larger study of Deaf identity. All interviews were transcribed then thematically analysed (See also Foster and Kinuthia, 2003).

Nikolarazi and Hadjikakou (Ibid) noted that a large methodological criticism of studies exploring mental health in D/HOH is that the instruments are inaccessible to D/HOH children. They found that the questions were impenetrable and they are frequently carried out by clinicians who have very little awareness of Big D culture. While the semi-structured questions in this research were not related to mental health, it was noted that some questions needed some extra explanation via the interpreter. This issue will be highlighted in the discussion section. Of course the

issues around comprehension, the use of interpreters and the issue of asking L1 questions to gain L2 answers all have to be taken into account.

The Nikolarazi and Hadjikakou study identified a mean age of diagnosis of hearing impairment at 20 months which would suggest that language acquisition issues could have confounded or made difficult the interview process. That research was carried out with Swedish D/HOH students and in Sweden parents of D/HOH children are offered sign language education as soon as diagnosis has been given.

Torres, Moreno-Torres and Santana (2006) also used a mixed method approach which involved an evaluation of linguistic Input support to a pre-lingually D/HOH children with cued Speech. Meins, Fernyhough, Wainwright, Clarke-Carter, Das Gupta, Fradley and Tukey, 2002, 2003) have highlighted the difficulty of gathering a large number of participants in the field of D/HOH studies and have also noted the difficulties around finding D/HOH participants who have no additional disabilities. The one aspect that is constantly missing in the research noted above was the lack of measurement of language capacity of the D/HOH participants: there is often an assumption that what is being asked is understood and that the L1 language easily translates into the L2 being used by the D/HOH participants. The difficulties outlined in the research above will be used to influence the delivery of the semi-structured interviews. It will pay particular attention to the use of language and use of interpreters to help with comprehension (For D/HOH participants) and understanding (For the Researcher).

3.10. Conclusion

This chapter has identified the main areas of research in the area of D/HOH including: Theory of Mind development, language development and acquisition in

D/HOH children, the effect of Cochlear implantation in D/HOH children, the use of sign language and translators in learning environments, neurological differences in D/HOH individuals compared to the hearing population. It also illustrated the effects of late language acquisition on Working Memory and finally gave some examples of methodologies used for interviewing Deaf individuals.

It is possible then to suggest the following findings from the literature review:

- D/HOH individuals have the same ability to think as Hearing individuals. However, the delay in language acquisition impairs this ability from developing at the same rate (Courtin, 2000, and Peterson and Siegan, 1999). When the delay in language acquisition is accounted for, it has been shown that second generation D/HOH individuals develop an age-appropriate Theory of Mind (Melot and Courtin, 2000, and Moeller and Schlick, 2006).
- Due to a delay in the diagnosis of hearing loss/deafness, it is likely that D/HOH children will have delayed language development and acquisition. This delay will impact on their ability to do well in I.Q tests that involve Verbal Comprehension (Crystallised Intelligence) (Braden 2004, Meadow, 1968, Bishop, 1983 and Quigley and Kind, 1980). It is likely that the delayed acquisition of language is never ameliorated over time. The impact on this delay has profound effects on academic ability and language proficiency. Again, this is not the case for second generation D/HOH children who access “language” in an age-appropriate manner.
- Tests that incorporate Verbal I.Q will diminish a Full Scale I.Q as Verbal I.Q will be as much as two standard deviations below the norm (Marschark, 2010, Braden, 2004, and Krouse and Braden, 2011). This is due to delayed

language acquisition and the fact that Hearing Parents may not model and expose their D/HOH child to structured language and fluency

- The delay in language development will also impact on a D/HOH child's vocabulary, reading skills, comprehension skills and mathematical ability (Marschark, 2000. 2010, Furth, 1971 and Convertino, Marschark, Morrison and Rizzo, 2010).
- The use of sign language can, and often is, complicated when administering tests or trying to communicate instruction (Marschark, Leigh, Sapere, Burnham, Convertino, Stinson, Knoors, Vervloed and Noble (2006). Having an interpreter does not “level the playing field”.
- The delay in language development and acquisition seems to impact on Working Memory skills. The use of sign language seems to take slightly longer to process in Working Memory thus reducing the capacity amongst the D/HOH population (Marschark, Convertino et al, 2010, Mayberry and Waters, 1991, Lichtenstein, 1998 and Marschark, 2014).
- The use of sign language can develop into an advantage for D/HOH participants as the development of visuo-spatial skills is supported by the act of sign language. The act of signing involves the use of temporal space and the ability to use different perspectives when communicating -particularly when one is conveying a conversation between two sign language users, (Gopnick, Slaughter and Meltzoff, 1994, Courtin and Merlot, 1992 and Marschark, Sapere, Convertino, Seewagen and Maltzan, 2004).
Consequently, D/HOH individuals have higher than average abilities in tests of visual-spatial skills.

- It would appear that D/HOH have some advantages in noticing movement and having more enhanced peripheral vision than hearing individuals (Corina et al, 1996 and Poizer et al, 1987) which has impacted on Processing Speed tasks in I.Q tests which may explain why previous PIQ test scores for D/HOH populations have been higher than the Hearing population norms (Krouse and Braden, 2011).
- There is a history of research indicating that D/HOH individuals have under-developed Working Memories (Marschark, Convertino et al, 2007). The main reason proposed for this finding is that the act of signing takes up more “space” in terms of information processing in short term memory (Wilson and Emmorey, 1998).
- Research into D/HOH individuals’ experiences of life in a Hearing world have shown that questionnaires have been difficult to administer and translate into sign language. The added challenge of comprehension and the use of L1 CALP may have hindered the process of qualitative information gathering.

Questions Arising from previous research which will be addressed in the present study:

In terms of how the literature review impacts on the present research, it seems reasonable to develop questions which might be addressed in the current study.

- Will the use of a Full Scale I.Q on the WISC-IV^{U.K} result in lower mean I.Q scores for the D/HOH participants as it can be expected that Verbal I.Q will lower the overall I.Q score?

- Will the mean Perceptual Reasoning Index score be the same for the Hearing population norm? (I.e. a standard score of 100). Previous Wechsler tests scored higher PIQ means for the D/HOH population. The most recent research on the WISC IV^{U.K} reported lower average scores for the Perceptual Reasoning Index amongst D/HOH participants. This was due to the removal of Performance ability subtests on the PIQ score.
- Will the mean Perceptual Reasoning Index score be similar to the Wechsler Test of Non-Verbal Reasoning mean for D/HOH participants? The reasoning behind this is that they are both seemingly a test of nonverbal *fluid reasoning* which equates to **g**.
- Will the mean for the Working Memory test on the WISC-IV^{U.K} be less than the mean for the Working Memory test on the WNV? The WISC-IV^{U.K} test should impact on Working Memory as sign is used to test memory. In the WNV I.Q test, finger pointing and visual memory are utilised which should advantage D/HOH sign users. It is anticipated that a visual Working Memory test should be to the advantage of the D/HOH participants.
- Will the use of interpreters be an advantage to D/HOH participants? The research to date suggests that using interpreters does not advantage D/HOH participants as they can often confuse the participant and split attention. It also involves testing I.Q in a L1 and assessing responses in an L2 which might confound or depress scores.
- Will ability to comprehend instructions affect the D/HOH participants? Previous research indicates that D/HOH delayed language acquisition can impact on comprehension and ability to follow instructions.

- Will the D/HOH participants understand the qualitative semi-structured questions and be able to offer expansive answers based on their own experience of the intelligence testing process?

The next chapter will show the results of these test questions and illustrate the difference between using sign language to administer the WISC-IV^{U.K} compared to the use of a non-verbal, non-signing test, the Wechsler Nonverbal Scale of Ability.

Chapter Four

4.1 Overview of the chapter

This Chapter illustrates the process involved in the research undertaken: it begins with the epistemological viewpoint of the author and positioning taken (Section 4.2) and outlines the researcher's thinking around his role in the process and how his epistemological position influenced the methodological approach and interaction with the D/HOH community.

The chapter continues with an outline of the research objectives (4.3), the research design (4.4), the procedures undertaken to gather the data (4.5) and the methods used to analyse the data (4.6). This Chapter illustrates the perspective of the author, his stance/perspective on how the research was to have been undertaken and illustrates the approach that was chosen for the gathering of data, the interviewing process and the methodologies that were best suited to the research undertaken.

4.2 Research Objectives and Rationale

As outlined in Chapter One, the aims of this research was to investigate the current government policy for educational psychologists when assessing the intelligence of D/HOH students. At present the current advice of the National Council for Special Education in Ireland is to administer psychometric tests through the medium of Irish Sign Language, ISL (NCSE, 2011, p. 65):

“The Council recommends that the NEPS should work towards a psychological service being available with a sufficient level of competency in ISL to administer psychological assessment through ISL”.

The researcher utilised the “Guidelines for the assessment of Deaf and Hard of Hearing children” draft guidelines from the researcher's organisation: The National

Educational Psychological Service (NEPS). These guidelines suggest that the Perceptual Reasoning Index of the Wechsler Intelligence Test for Children (WISC-IV^{U.K.}) 4th edition (Harcourt Assessment, 2004) be used as a reference point and that scores be compared with the I.Q scores calculated from the Wechsler Nonverbal Scale of Ability (WNV, 2006).

The rationale for the research was influenced by a transformative-emancipatory framework (Mertens, 2003, p.159,) which focuses on the implicit aim to create a more “just and democratic society” by redefining the process of assessing the cognitive abilities of D/HOH children. Robson, (2011, p39) identifies this approach as a way of bringing about change activities; “The study itself leads to change, or indirect(ly) through influence on policy”. Underpinning this approach necessitated the use of a mixed methods approach. By definition, and in order to include the voice of the participants, a questionnaire and semi-structured interview was conducted with participants to gain their views on the process. However, the main aspect of the research focused on the quantitative statistical information gained by using the test instruments. Therefore the aim of the research was to be as inclusive as possible by eliciting the participants’ views on intelligence and by asking them what they thought about the testing process: more specifically, whether they thought their intelligence has been tested and what testing method they preferred. As part of the process, their views and the data collected would be used to bring about change through recommendations made to practising educational psychologists and to influence government policy.

As the author has some reservations around the present National Council for Special Education (N.C.S.E) policy regarding the assessment of D/HOH children (N.C.S.E., 2011), there was an objective of investigating this policy with a view to

suggesting amendments where appropriate. Private conversations held with NCSE management suggested that the recommendation for the use of ISL was from the D/HOH community and was not based on research. This aspect of the research was influenced by an emancipatory approach in that the author believed that current N.C.S.E policy was promoting the underestimation of D/HOH individual's intelligence scores. The policy advice from the N.C.S.E was viewed as something that needed further investigation based on the author's field experience and work with the D/HOH population. The use of an interpreter to administer intelligence tests through Irish Sign Language was not promoted by the National Educational Psychological Service (N.E.P.S. 2010) draft guidelines as research suggested that this would lead to an underestimation of cognitive ability in the D/HOH population. Whether these NEPS guidelines were made available to the NCSE at the time of their research is not known. The fact that the NEPS guidelines were in draft form would suggest that they were not made available to outside agencies.

As the research participants were D/HOH, the ethical dimensions of working with a vulnerable group are discussed. A methodology section includes information about the participants, the procedure used to collect data and the approaches to analysing the data gathered.

4.3 Context and Location of the Study.

The Research was undertaken throughout The Irish Republic and focused mainly on large urban areas which had Deaf schools such as Limerick, Dublin, Kilkenny and Cork. A map of Ireland is supplied on page 89 to aid the reader identify locations.

Some participants resided in the Deaf schools in Dublin during the academic year but as the data gathering took place during the summer, they travelled to Dublin

where the research was based or the researcher travelled to local offices of Deafhear.ie, a charity that funded and supported the research. DeafHear.ie is a nation-wide organisation that supports both Hearing and D/HOH families of all ages. It has dedicated family support workers, social workers, family therapists and “Deaftech” specialists. Participants from towns such as Wicklow, Fermoy, Galway and Athlone were also represented.

The Researcher did two phases of research during the summer months of June and July of 2012 and in December 2012 and January of 2013. The first phase of research was undertaken in the Deaf Education Centre in Cabra, Dublin, in the offices of Deafhear.ie in Dublin, Kilkenny city and in Limerick city. Ninety percent of the participants were tested in this first phase.

The second phase was in December 2012 and January 2013 in Cork city at St Columba’s Girls’ School with facilities for Deaf Children where eight participants were tested.

Figure 4.B Map of Ireland



4.4 Epistemological Perspective.

The nature of knowledge and how we know (*epistemology*) is an essential starting point for the research process. Epistemology is the branch of philosophy which examines questions about the nature of knowledge and how we process the acquisition of knowledge. Foucault, (1980, p.16) describes it as a “system of possibilities for knowledge”. In order to develop a methodology of how to gather information on intelligence testing in D/HOH students, it is important to develop a paradigm around what methodology is used to gain this knowledge and to reflect upon whether these methods reflect the epistemological viewpoint. The researcher’s interaction with this knowledge gathering must be influenced by the epistemological positioning. Essentially the researcher must ask “what is the best and most secure way of acquiring knowledge?” (Grayling, 1998, p9). Grayling suggests that “To know something one must believe it: one’s belief should be true and your reason for belief should be satisfactory in the light of some standard” (ibid, p9.)

The beginning viewpoint around the measurement of intelligence is that it is something which exists and something which can be tested. Intelligence as a concept could be doubted initially until a relationship is shown between “intelligence” as we measure it and outcomes that illustrate intelligent behaviour (a person with a high I.Q should have quicker problem solving ability, have a wider store of measurable knowledge and be able to demonstrate skills that person of lower I.Q could not do, for example). The intelligence tests used in this research follow the tenet that the tests measure “performance” rather than intelligence per se (Flanagan and Kaufman, 2004, p9). The Irish education system is set up to develop and promote learning and it is presumed that “intelligent” people will succeed in this area. The system tests students in a terminal exam which decides which are the highest

achieving students. Generally, high achievers proceed to third level education on the basis of their test results. Intelligence tests predict who will do well in these kinds of academic tests.

Grayling (1998) and Blackburn (1999) highlight the concept of “Propositional knowledge” which is knowledge of a real situation in the world. It is Propositional knowledge that the researcher seeks. If we can argue logically that intelligence means being a faster better problem solver than others...then people with high intelligence will perform better than people with low intelligence on certain tests. This is called “justified belief”.

The research undertaken in this thesis was based on propositional knowledge in that it assumed that “intelligence” was measured and furthermore, that “intelligence” is what is measured by tests of cognitive ability which predict academic success. It is what Robson (2011, p5) calls “Real world research”: challenging what happens on a day-to-day basis in the world of educational psychology.

4.5 Pragmatism.

Pragmatism is the philosophical tradition that seeks to provide a link between theory and practice which is best suited to the author’s belief system.

“Pragmaticism”, originally coined by Charles Sanders Peirce in 1905, is an approach whereby an idea, theory or test has a clearly defined acceptance of general practice as its starting point. While it is necessary and right that we produce theories as part of a natural pursuit of knowledge, we must test our theories in *practice* to evolve and expand our beliefs. Theory and practice are not separate entities but rather inform and expand each other through use and practice in the everyday world. John Dewey argued that it was not a matter of either Theory or Practice, but rather of having

informed or intelligent practice. In this research, the accepted theory of intelligence is that of the CHC model (explained in Chapter One) and the practice of testing “intelligence” is utilised in popular tests such as the Wechsler series. The theory of testing intelligence in a D/HOH population was tested by the use of two intelligence tests in the desire to inform future practice and to critically evaluate current practise and policy.

Many have argued that Pragmatism is simply relativism or at best practicalism (Hildebrand, 2003). The notion that an idea has to survive or be proven in the real environment can seem to some to be lacking in pure philosophical methodology as there is no distinction between methodology, theory and philosophical stance. It can be simplified as “what has been proven to work and is accepted by the environment in which it works”. In a world that can be obsessed with ideas and ideologies we can often lose track of how these ideas impact on real lives: Louis Menand (2001) shows how the use of ideologies of Capitalism and Communism impacted on societies in the last sixties and seventies. Other examples abound: Thatcherism, Reganomics, McCarthyism, Fascism spring to mind. Mertens (2010, p10) argues that the “practical demands of (that) particular situation” require a researcher to have paradigms to test so that they can become transformed and revised. Floden (2009) gave an example from Dewey who argued that practical research is more about how to change or do something differently, it is essential that the researcher focuses on a practical activity. For Dewey, change equals learning which is a key aim of most educational research. In educational psychology, change is the currency in which we operate: we are expected to assess problems, suggest intervention and to bring about change, hopefully for the better. For the researcher then, a mixed methods approach would therefore be most appropriate: one where both the format of intelligence testing is

indeed, tested, and where D/HOH students give their view on the process and their definition of intelligence. As the researcher seeks to change or at least improve current practice, one must test what is current practice and therefore the Policy Advice Paper of the N.C.S.E (2011) is chosen specifically for investigation.

Therefore, the epistemological stance taken in this research has been informed by Pragmatism as it gives the researcher the opportunity to move beyond pure idealist and Cartesian philosophy and embrace an empiricist approach which enables one to seek to interpret data, analyse this data in the light of the experience of D/HOH student's and use this information to inform, change and ultimately enhance our knowledge. There is an underlying belief and acceptance that we can know what intelligence is and that psychologists can use tools of measurement in both a qualitative and quantitative way to learn how to empower and emancipate individuals in our society. William James states "the true is the only expedient in our way of thinking" (James, 1909, p 222) and suggests that the "truth is what works" (Ibid, p.98). If the challenge for this research is to investigate Intelligence testing in D/HOH students, we must get out and find out what "works" and ensure that this method is used from now on. If the truth is that we should use ISL when testing the intelligence of D/HOH individuals, then we can verify it through the data and if it is not then we must suggest an alternative to inform educational psychologists in Ireland and further afield.

4.6 Aims of the Research

The research question initially formulated sought to investigate whether administering the WISC-IV^{U.K} through I.S.L. would produce scores comparable to that of the non-verbal aspects of the WISC IV^{U.K} called the Perceptual Reasoning

Index. It also wanted to investigate whether scores from the Wechsler Nonverbal Scale of Ability (WNV, 2006) were comparable to the test scores obtained by D/HOH individuals on the WISC-IV^{U.K}. In theory, the scores should be the same as the same construct (general Intelligence or **g**) is being measured. It was believed that the administration of the WISC-IV^{U.K} through ISL would depress scores as historically D/HOH student populations have produced quite low verbal comprehension scores in intelligence tests (A full discussion on the difficulties facing D/HOH children acquiring language were identified in Chapter Two). It was envisioned that W.I.S.C. IV^{U.K} scores would be lower when administered through I.S.L. and that there would be a significant difference between these scores and those obtained through a nonverbal test of cognitive ability: the Wechsler Nonverbal Scale of Ability (2006).

The second aim of the study was to evaluate the challenges and difficulties that arise when using I.S.L. to administer tests of intelligence to D/HOH students. The questions of whether I.S.L. is “fit for purpose” and whether students could be adequately tested via their preferred mode of communication were addressed.

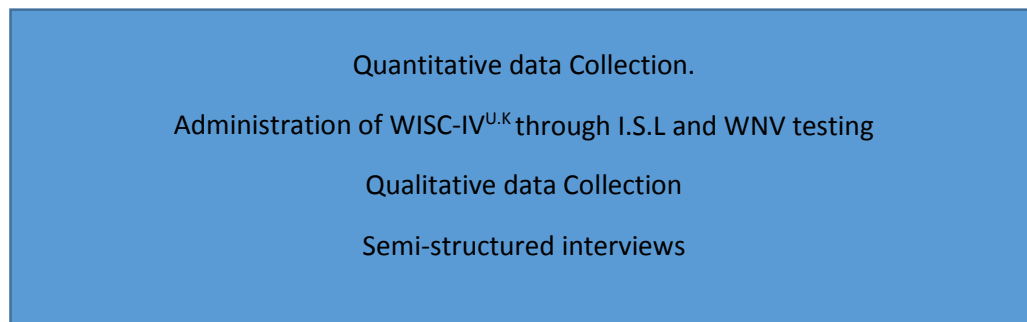
Another aim of this study was to garner the opinions of D/HOH students on what they believed to be “intelligence” and to ask them whether they felt that the tests administered actually tested their intelligence. Their opinions and experiences of being tested were elicited and were used to formulate recommendations. The task of setting up a design and developing a methodology for undertaking this research is discussed in the next section.

4.7 Research Design: Using a Mixed Methods Approach to Answer the Research Questions.

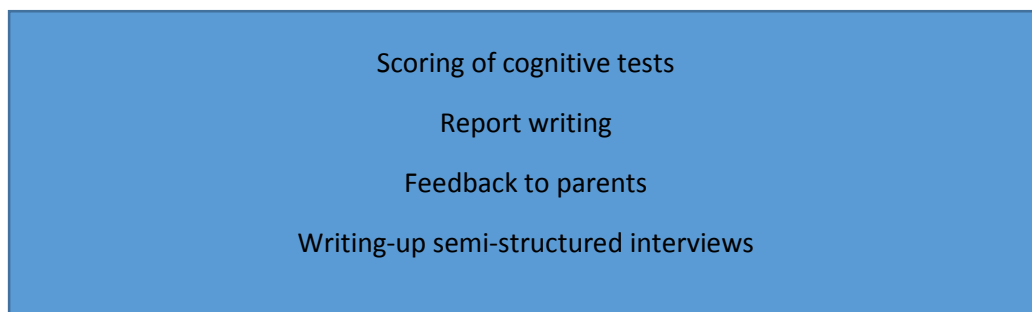
The research design utilised in this research is an explanatory sequential design (Creswell, 2005). This approach was undertaken as the research itself was a process that lasted for over three years. The point of utilising this approach allowed the research to develop and change as experience was gained. Aspects of the research were adapted and changed as the process developed. For example: a section on the issues of using translators and I.S.L. emerged from the study which led to further investigation and involvement with a group of D/HOH adults doing “back-translation” from the Interpreter to compare it to the administration language in the WISC-IV^{U.K.}. This was not a part of the initial design but something that grew organically out of the research itself. It proved to be a fascinating and informative aspect of the research that may indeed be influential in future research in the area of hearing impairment.

The process involved a three phased, mixed methods design of collecting quantitative data by administering cognitive tests, followed by an interview with the participant in which their views on “intelligence” were explored by use of a semi structured questionnaire. The third phase of the study looked at the use of Irish Sign Language as a mode of communication in the process of testing the concept of **g** or general intelligence.

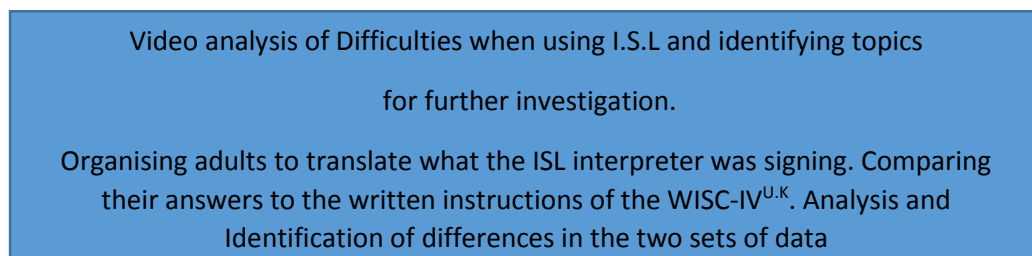
Figure 3 A. Phase one: Data Collection, Report writing and Feedback



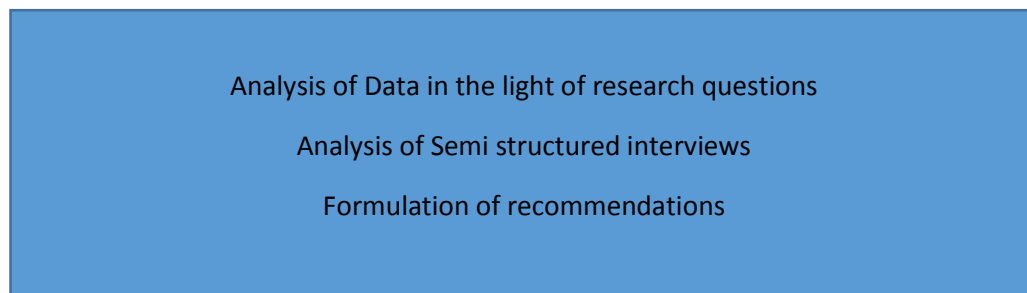
Then



Phase Two: Back-Translation and analysis



Phase Three: statistical analysis of standard scores and analysis of semi-structured interviews. Comparison of Back-translations and identification of problematic instructions.



4.8. Pilot study.

Five pilot interviews were conducted in order to establish if it were possible to administer the WISC-IV ^{UK} through ISL as there may have been difficulties with the translation of certain phrases or the overall translatability of the WISC-IV UK may have been problematic. Three qualified I.S.L. interpreters were interviewed and shown examples of the WISC-IV^{U.K} before the study to identify possible difficulties with the instructions and individual test items within the Verbal Comprehension subtests (Similarities, Vocabulary and Comprehension). To maintain the integrity of the test materials, only one subtest was shown to each individual interpreter. The main interpreter involved in the assessment of all the Dublin participants offered feedback about test items and the suitability of test materials in the WISC-IV^{U.K} on an on-going basis and this input was influential in the development of the back-translation study. The semi-structured interview was adapted and changed on the advice of a principal of one of the Deaf schools and three leading members of the D/HOH community. It was felt that some items on the interview schedule were too complex and indeed, this was brought up by members of the research proposal team that assessed the application to the University of East London. Items were changed as a result of the interaction with the UEL team, the interpreters and members of the D/HOH community.

As part of an introduction to the questionnaire, students were asked whether they found the tests difficult and what parts of the tests they had enjoyed the most. As the researcher was unable to carry out digital auditory recordings of these interviews and believed that videotaping could be potentially intrusive, contemporaneous notes were taken during the interviews. In order to preserve the collaborative approach and to ensure that the participants were respected, it was decided that videotaping would

not be carried out. The Interpreter asked the questions in I.S.L. while enunciating the questions. This process freed-up the researcher to make detailed notes.

While the D/HOH student responded, the researcher took verbatim notes and clarified when necessary. As I.S.L. is such a succinct language and the emphasis is on shortening and encapsulating meaning in short phrases and facial expressions, it was possible to make notes while the translator communicated with the participant. A grid of recorded replies from each of the participants is located in the Results Chapter and the list of questions used in produced in Appendix E.

4.9 Duration of the Study.

The research required a good deal of planning and strategizing before the data collection took place. While ethical approval was granted from the University of East London, the researcher's employer (NEPS) had a separate ethics approval process which began in March of 2012 (Appendix L). The researcher had planned on using the months of June and July of 2012 to undertake data collection but ethical approval from NEPS took much more time than anticipated and data collection only began in the second week in June 2012.

As part of the rationale of the research was to be as inclusive as possible, it was felt that it was necessary to establish a link with the major organisations involved with providing services to the D/HOH Community. The researcher had met with the Chief Executive Officers of Deafhear.ie and the Catholic Institute for Deaf People (C.I.D.P) who both were willing to offer logistical assistance.

Meetings were held with the three Deaf schools in Dublin and Limerick. The researcher met with the principals of St Joseph's Boy's School for the Deaf and St Mary's Girl's School for the Deaf. After two information meetings both schools

agreed to endorse the research. The information sheet and invitation to participate (Appendix F) were given to students in both schools. The majority of the research was completed in the month of June and the first two weeks of July 2012. The intensity of administering two cognitive tests a day and holding consent meetings with parents as well as completing the semi-structured interview meant that the demands on the researcher and the interpreter were challenging. The researcher utilised the relative “down-time” of the remainder of the summer months to score and write feedback reports for each participant (See appendix G for a sample report).

In December of 2012, St Columba’s Girls’ National School with facilities for Hearing Impaired Children in Cork, engaged in the research and the researcher visited the school for three days, assessing six children with the support of two SNAs who communicated for the children. Due to time constraints, a second visit had to be organised in January when all interviews and assessments were completed. All feedback reports were posted to parents by the end of January and the third phase of the research began. Two additional students from Limerick were tested during this time as they had been too young on the first visit.

Analysis of most of the scores and the semi-structured interviews began in the summer of 2013. This delay was due to illness which impacted on the researcher up to November of 2013. During the analysis of the answers given by participants, through observations of the interpreters used and conversations held with the main interpreter, the researcher noted that there was some difficulty translating items into I.S.L. which may have led to misrepresentation of the questions and the instructions. This was further explored with the main interpreter, through follow-up reading and conversations with members of the organisations who deliver services to the D/HOH community.

4.10. Ethical Considerations.

Informed consent was a very important aspect of the research in that it was underpinned by a transformative-emancipatory framework (Mertens, 2003, p.159). It was important for the participants and their parents/guardians to have ownership of the process and indeed the product (The final report). Each initial meeting included the child in the process and the advantages and disadvantages of the assessment itself were explained to both parents/guardians and the children who participated. Participants were given an opportunity to ask questions and to seek clarification around the testing, storage of the information and how this information would be shared. It was essential that parents/guardians were made aware that the researcher was not working for the school which the child attended, that the report would belong to the parents/guardians and that they would have final say with regard to who saw the report. The participants were also asked for their consent and were asked to sign the child-friendly consent form. Each participant and their parents/guardians were informed that the testing could be stopped at any time and that they could withdraw their consent for the data to be used at any time up to the writing of the reports. One child withdrew consent during the first test despite encouragement from parents and this was respected and acknowledged as the child's right to withdraw. The parents subsequently arranged another appointment during which the child again withdrew consent. The reports were issued directly to the parents/guardians and it was their decision whether to share the information with the school in which the child attended. As part of the process of gaining informed consent parents/guardians were also given the opportunity to take time out to consider their response. In all occasions

consent was obtained from the parent/guardians of each participant and bar one instance, each participant gave consent.

Students and parents were asked whether they had a preferred interpreter when informed consent was being explained and agreed. Often, pupils preferred to have their SNA interpret for them or indeed a teacher. This was also the case in Cork where an SNA was preferred over the use of a qualified interpreter despite the fact that a professional interpreter was available. Sometimes if a student is not confident they may be inhibited by the presence of a stranger. Also, as I.S.L. is a fluid language, signers may often develop personal signs that are known only to their close friends and family or communicators.

The reports were sent to the parents of each participant and were identified as the property of the parents/guardians. Most parents expressed contentment with the format of the reports and the feedback offered. In two cases students were referred to other professionals for further investigation of difficulties identified during the testing. One with suspected neurological difficulties and another student who presented with Autistic-type difficulties. One parent required further advice on second-level placement for her child.

4.11 Interaction with the Deaf Community.

In early 2013, the Irish Deaf Society had begun to return e-mails and had agreed to meet with regard to the research. When a meeting was held, the researcher had developed the idea of testing the use of I.S.L. through the medium of “back translation”. A proposal was made to the I.D.S. that they might organise participants to take part in the process of back-translation using a video of the main interpreter issuing instructions and questions from the WISC IV^{U.K.}.

The I.D.S. agreed to organise eight D/HOH adults who were native ISL signers and who worked in the area of education to participate in back-translation. A room was organised at the I.D.S. offices during the month of May, 2013. Participants were shown videos of two phrases or questions of the WISC IV^{U.K} translated by the main interpreter in the research. They were then asked to write down what they had seen the interpreter sign. It was important to maintain the integrity of the WISC IV^{U.K} as test material should never be made public. This was managed by only showing two questions to each participant as well as ensuring that only adults participated.

4.12 Method.

All quantitative and qualitative analysis was completed by end of March 2014. The qualitative analysis of the semi-structured interviews used broad-based thematic analysis (Braun and Clarke, 2006) where each interview was broken into themes and a commentary was provided. Each participant was asked a set of questions but was allowed to offer thoughts and comments beyond the set questions. Each response was transcribed as the participant answered and were then categorised into themes and comments that related to each other. As the students were, in some cases quite young (aged six in some instances) the answers were quite common and, in a sense, somewhat predictable. As the students expressed their ideas on intelligence and being clever or “bright” it was quite clear that many had a notion of *being good at school* equalled being clever. The importance of asking students what tests they found were hard or better and whether they tested how “clever” they were was more informative in that answers differed according to particular skill sets. For a full description of the feedback from students see Chapter Five.

The quantitative analysis used the information gathered from the two tests and broke that information into the four scores that are commonly used by Educational Psychologists: the Full Scale I.Q of the WISC-IV^{U.K}, the Perceptual Reasoning Index of the WISC IV^{U.K}, the Two Test Ability score of the Wechsler Nonverbal (WNV) and the Four Test Ability score of the WNV. The research question asked whether there would be a difference in scores of the WISC-IV^{U.K} delivered through ISL and those of the WNV. The Null Hypothesis was that there would be no difference and the researcher predicted that the Full Scale I.Q score of the WISC IV^{U.K} would be considerably lower than the other three tests. The Two Test score of the Wechsler Nonverbal was predicted as being the test that would produce the highest score as there was a question around the use of the Picture Arrangement subtest in the WNV Four-Test which may have some aspect of language involved. The distinction between a nonverbal test and a test of nonverbal intelligence has been covered in Chapter Two. The WNV tests intelligence or *g* but it was suggested that Picture Arrangement may have been affected by a language component.

A series of T-Tests using an SPSS 22 package were carried out to see if there was a statistical difference between the WISC IV^{U.K} and the WNV Four Test score, The Perceptual Reasoning Index of the WISC IV^{U.K} and the WNV Four Test and the WNV Four Test and the Two Test scores.

A one-way Anova was carried out to test the relationship between the Working Memory aspects of the WISC IV^{U.K} and the WNV, namely the Digit-Span and Arithmetic (WISC-IV^{U.K}) and the Corsi Blocks/Spatial Span (WNV), subtests. This was to see if there was a difficulty of administering essentially auditory tests of the WISC-IV^{U.K} through ISL and a visual test on the WNV. All three tests were linked to Working memory.

A correlational test was also used to check for test-retest effect: to see if there was some practice element effect on completing the Coding test and the Matrix Reasoning test twice in one sitting. This was the only subtest that was tested twice and it was important to see if there was evidence of a practice effect.

4.13 Demographics.

There are 2,300 D/HOH children attending school in Ireland (CSO, 2011). However, as of 2011, there were 206 children attending specialist D/HOH schools or units attached to mainstream schools (NCSE, 2011, p27). This study initially took a representative sample of 34 which represents 16.5% of the total D/HOH school-going population who use ISL as a L1. Given that the WISC IV^{U.K} used .00025% of the U.K's school-going population (Office of National Statistics, 2004) the author is satisfied that the sample used is quite robust. The total number of participants numbered 34. The gender split was 13 girls and 21 boys. Three participants were excluded from the study due to the presence of a co-morbid conditions in two participants (one had an identified language impairment (girl), one was suspected of being on the autism spectrum by the researcher and one did not use ISL as a primary mode of communication (both boys). This left the number of participants at thirty-one with a 12/19 split between boys and girls.

The mean age of participants was twelve years and five months. The age range of participants was 6 years and three months to sixteen years and six months.

In terms of communication, sixteen participants listed ISL as their primary mode of communication, and fourteen used "total communication" (a combination of ISL, speech and lip reading). All participants were able to communicate via ISL.

The average age of diagnosis of a hearing loss was three years and zero months. Participants ranged in age of initial diagnosis from six months to five years of age. Participants who used cochlear implants often had to wait a year from diagnosis to “switching on” and thus the age calculated was the age of “switching on” as this is the age when participants had an ability to access sounds and speech.

In terms of the level of severity of the hearing loss for the participants, the most common level was “Profound” hearing loss (seventeen participants) followed by “severe” (nine participants), “Mild” (Two participants) and “Moderate” (two participants). Seven participants used a cochlear implant while twenty one wore hearing aids. There was one participant who was a second generation D/HOH child and he used ISL. One participant (male) was described as a child who “sometimes” wore a hearing aid.

The sample of participants is important in terms of the demographics of the D/HOH community as the group used had no co-morbid conditions, used ISL or Total communication (with ISL included) as their primary mode of communication and had acquired hearing support via a cochlear implant or hearing aids at roughly three years of age. The group is as homogenous as can be expected in this most heterogeneous community (Marschark and Spencer, 2011).

Participant’s parents responded to the video posted on Deafhear and the Catholic Institute for Deaf People websites seeking participants. Some parents responded to the letters sent through the Deaf schools in Dublin, Limerick and Cork while others decided to become involved after hearing about it through an organisation called “Share the Journey”- a parent organisation set up to promote the needs of D/HOH children trying to access services in Ireland. In total forty participants were referred

but six were just over the age limit of the WISC IV^{U.K} in June 2012 and had to be excluded. The WISC IV^{U.K} only produces norms for children from the age of six years to sixteen years eleven months. Some children referred from the Limerick school were under six years of age and had to wait a number of months before they could be tested. The requisite that participants should be diagnosed as being “D/HOH” and that they used ISL as a primary source of communication were the exclusionary criteria. Participants with co-morbid conditions were excluded as the research wanted to focus on purely D/HOH individuals who used ISL as their primary mode of communication.

Participants ranged in age from six years to sixteen years and there was roughly a ratio of 2:3 gender split in favour of boys. In total thirty three participants were involved and two were excluded as outliers (one with an exceptionally high I.Q and one with an exceptionally low I.Q). All participants used ISL and were tested through this medium during testing. While some could lip-read and speak, ISL was used to communicate questions and instructions.

Socio-economic status.

Participant’s parents were not asked what their socio-economic status was or whether they worked or not. As the aim of this research was driven by emancipatory ideas and philosophy it was decided that questions would only be asked as to the level of hearing impairment, whether the child had a bi or uni-lateral hearing loss, whether parents used ISL and whether parents were D/HOH. Other questions as to whether the child was using a cochlear implant and at what age were they diagnosed were also asked as these facts have foundation in the present research around

deafness and the correlation between age of detection and level of language usage
(See appendix H)

Four main Deaf schools were identified as the educational provider for the participants: St Joseph's school for Deaf Boys, St Mary's School for Deaf Girls (in Dublin), the Midwest School for Hearing Impairment (in Limerick) and St Columba's Girls National School with Facilities for Deaf Children (in Cork).

98.07% of participants came from these three schools. The remaining participant attended a specialist unit attached to a mainstream school.

4.14 Choice of instruments: rationale.

There is a wealth of instruments currently available for the non-verbal measurement individual cognitive ability. McCallum, Bracken and Wasserman (2001) have offered a comprehensive analysis of the most popular instruments including the Universal Nonverbal Intelligence Test (Bracken and McCallum, 1998), the Leiter-R (Roid and Miller, 1997) and the Test of Nonverbal Intelligence, fourth edition (Brown, Sherbenou and Johnson, 2010).

The Leiter International Performance Scale- Revised, (Leiter-R, Roid and Miller, 1997) is nonverbal test of fluid Reasoning, Visualisation, Visuospatial Memory and Attention. It was developed specifically for "those with significant communication disorders, cognitive delay, English as a second language, hearing impairments, motor impairments, traumatic brain injury, attention-deficit disorder and certain types of learning disabilities" (Roid and Miller, 2010, p1). A sample of sixty-nine Deaf and Hard of Hearing individuals were included in the norming process. McCallum, Bracken and Wasserman (Ibid) have noted that all of the Leiter-R subtests are classified as either Poor or Fair correlates of *g* using Kaufman's (1994)

measurement criteria. It is also worth noting that three of the subtests have a verbal component built within them: the examiner has to verbally indicate how much time is left to examinees (Roid and Miller, 1997, p21). McCallum, Bracken and Wasserman (2001, p203) suggest that the “Leiter-R requires some verbalisation and includes an array of gestures and pantomimed instructions that are vast in number and seem vague or confusing at times”. The Leiter-R can take up to one hour to administer and some items in the test allows for a delay time of up to thirty minutes (McCallum, Bracken and Wasserman, Ibid, p158). It was clear that this test would not be suitable for three main reasons: The test could not be administered in parallel with the WISC-IV due to time considerations and the demands on the examinee, the presence of some verbal components within the subtests and finally the date of the test which places it in a position whereby the norms may have changed over ten years.

The Universal Nonverbal Intelligence Test (UNIT, Bracken and McCallum, 1998) is a similar test to the Leiter-R in that it is considered a multi-dimensional intelligence test that utilises various nonverbal methods to assess general intelligence or *g*. Rather than producing an assessment of Fluid Reasoning, the UNIT reports a Full Scale I. Q score which is fully consistent with the CHC model of intelligence. Bracken and McCallum (Ibid, p15) indicate this conceptualisation thus: “The UNIT makes possible a glimpse of the examinee’s verbal and performance abilities as measured through a nonverbal medium”. This is an interesting statement in that the authors of the UNIT indicate that there is, by definition, an aspect of the test which measures verbal mediation skills (Ibid, p14). McCallum, Bracken and Wasserman (2001, p128) also highlight a mean standard score of between 6.81 and 8.72 for D/HOH individuals and specific speech and language difficulties from the mean standard score for the normed sample. Again this test was deselected due to the date of the test (1998),

the presence of some verbal language impact on the mean scores of D/HOH individuals and the lack of reference to D/HOH individuals in the administration and scoring procedures of the manual (Bracken and McCallum, 1998, pp 37-40).

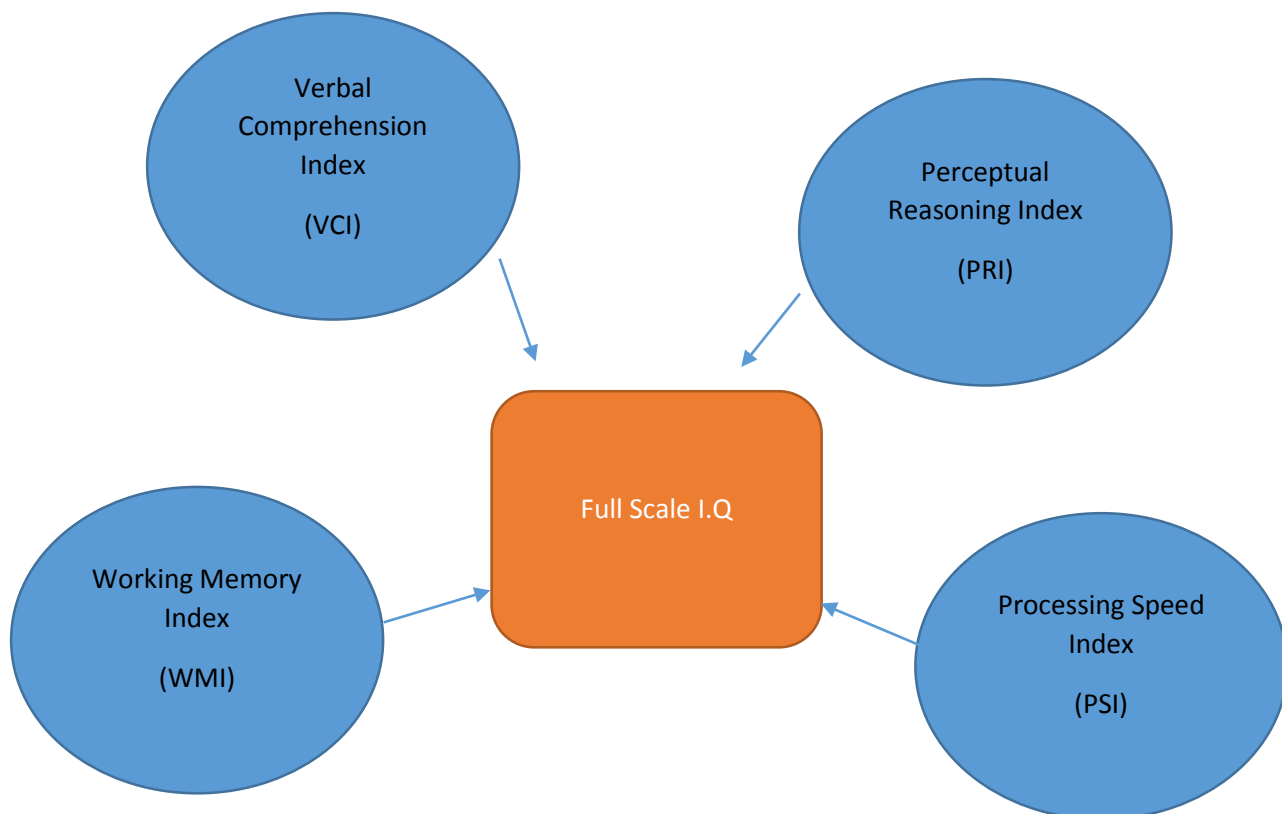
The Test of Nonverbal Intelligence (4th edition, TONI-4, Brown, Sherbenou and Johnson, 2010) was also considered for use in the current research. The TONI-4 is an individually administered assessment tool that measures **g**. It specifically purports to measure both fluid Intelligence and general intelligence (Titter, Clinic, Navruz and Bae, 2011). It is based on the hierarchical model of intelligence as outlined in the CHC model and at the time of writing was the most up-to-date test of nonverbal test of intelligence. The testing time is similar to the The Wechsler Nonverbal Scale of Ability (WNV, 2006) and has specific reference to D/HOH groups in the manual (Ritter, Kilinic, Navruz and Bae, 2011). This test was deselected due to the unavailability of the test in the National Educational Psychological Service (N.E.P.S) at the time of the research.

The WISC- ^{U.K} is the most commonly used test in the Western World (Flanagan and Kaufman, 2004) and is the test kit supplied to each individual in N.E.P.S on entry to the service. The Wechsler Nonverbal test of Ability (WNV) is a commonly used test for the D/HOH population and is the recommended test in the N.E.P.S guidelines for the assessment of D/HOH children. As these tests have the same theoretical background and have U.K norms, coupled with their availability and following from the recommendations from the N.E.P.S guidelines for the assessment of D/HOH children, they were chosen to be the instruments used. The following sections discusses and outlines the two test instruments used in fuller detail.

4.15 Instruments used.

The Wechsler Intelligence Scale for Children (WISC-IV^{U.K}) is a widely used, individually administered, comprehensive instrument for assessing the cognitive ability (Intelligence) of children between 6 years and 16 years 11 months (Glass, Ryan, Charter & Bartels, 2009 and Watkins, Canivez, James, James and Good, 2013). The WISC-IV^{U.K} is comprised of 15 subtests (10 core and 5 supplemental), each dealing with a different aspect of cognitive functioning. When these are combined, they yield an estimate of general cognitive functioning in the form of a Full Scale IQ (FSIQ). The WISC-IV^{U.K} also groups an individual's abilities into four ability factors, also known as 'factor indexes', namely Verbal Comprehension (VCI, made up of the Vocabulary, Similarities, Comprehension, Information* and Word Reasoning* subtests), Perceptual Reasoning (PRI, made up of the Block Design, Picture Concepts, Matrix Reasoning and Picture Completion subtests), Working Memory (WMI, made up of Digit Span, Letter-Number Sequencing and Arithmetic* subtests) and Processing Speed (PSI, made up of Coding, Symbol Search and Cancellation** subtests). A description of each of these subtests is provided in Appendix A).

Figure 4C WISC-IV^{U.K.}. The Four Indices of the WISC-IV^{U.K.}



The Wechsler Intelligence Scale for Children-fourth U.K Edition (2004) is the most commonly used test in the Western World for the cognitive assessment of children aged six to sixteen years eleven months (Urbina, 2011). The WISC-IV^{U.K.} provides “A measure of global intellectual functioning, as well as indices of some of the specific cognitive abilities required for learning (Wechsler, 2003, p.iv). The WISC-IV^{U.K.} “facilitates the measurement of cognitive abilities in many special populations including children who are deaf or hard of hearing” (Ibid, p.13). However, the authors point out that “It is clear that further psychometric studies are needed to establish empirically derived standards for the use of the WISC-IV^{U.K.} with a variety of Deaf and Hard of Hearing individuals (Ibid, p.13). The WISC-IV^{U.K.} identifies four methods of communication which may be applicable when testing deaf or hard of hearing

children: Sign Language, Simultaneous Communication, Cued Speech and Aural/Oral.

In Table 1.4 of the manual the authors identify which subtests may not be administered as there may be difficulties with administration or communication these include:

Similarities: Administration may be problematic.

Digit Span: Interpretation may be difficult.

Vocabulary: Administration may be problematic.

Letter-Number Sequencing: administration is NOT recommended.

Comprehension: Administration may be problematic.

Picture Completion: There may be some difficulties with Linguistic issues

Cancellation: the timed nature may affect performance and interpretation

Information: Administration may be problematic.

Arithmetic: More difficult items may require additional modification.

Word Reasoning: Administration may be problematic.

The only items that can be administered without modification include: Block Design, Coding, Symbol Search, and Cancellation but timing issues may have an effect on performance. Overall, the WISC-IV^{U.K} manual suggests that the calculation of a Full-Scale I.Q is not recommended nor the calculation of a Working Memory Index score. The issue of Working Memory and the Calculation of a full-Scale I.Q score has been addressed in Chapters Two and Three.

4.15.1 Overview and Organisation of the WISC-IVU.K

As well as providing a general estimate of intellectual ability (FSIQ), profile analyses of an examinee's WISC-IV^{U.K} test results allow discrepancy comparisons between factor index scores, as well as subtest-level discrepancy comparisons (Flanagan & Kaufman, 2004). Such an intra-individual analysis or 'ipsative approach' to profile analysis is frequently recommended in analysing students' learning profiles (Glass et al., 2009; Sattler, 2008). The advantage of an intra-individual analysis approach is that it allows for the development of educational interventions based on a student's unique learning profile. As Sattler (2001) argues, "providing a unique profile of the child's ability" (p.38) must be linked with effective and personalised interventions.

4.15.2 Technical Adequacy of the WISC-IV^{U.K}

The WISC IV was originally standardised on a sample of 2,200 American children, who were selected in 2002 to match U.S. census data on demographic variables such as age, gender, geographic region, ethnicity and socio-economic status (Flanagan & Kaufman, 2009). 200 children were divided into each of 11 age groups, with the sample split equally between boys and girls. Norm tables were divided into 4 month age intervals across the age span of the test. Kaufman, Flanagan, Alfonso and Mascolo (2006) describe the match between the standardisation data and the U.S. population as "exemplary" (p.283). The WISC-IV has also been adapted and standardised in the United Kingdom, Canada, France, Australia and Germany and in Japan (Flanagan & Kaufman, 2009). This is important in ensuring cross-cultural validity, as intelligent behaviours can vary across cultures or subcultures (Nettlebeck & Wilson, 2005). Unfortunately, the Wechsler scales have not been standardised on an Irish population but one study by Watkins, Canivez, James, James and Good

(2013) has evaluated the efficacy of the WISC-IV^{U.K} with an Irish population and reported that focus should only be on the FSIQ level and to “Interpret factor index scores with extreme caution” (Ibid, 2012, p 109). This means that interpretation of test results in Ireland are based on standardised data from the U.K. and, as a result, may be open to cultural bias. However, it is considered that the WISC-IV^{U.K} provides a sound measure of general intelligence both for the general population and for a number of special groups (Wechsler, 2003). Again, it must be noted that this test is the preferred choice of NEPS psychologists in Ireland.

4.15.3. Special Group Studies

The WISC-IV^{U.K} includes some test score results for special groups to help provide information about the tests’ specificity and its clinical utility for diagnostic assessment (Hebben, 2004). Specialist groups studied include children with an autism disorder, children with Asperger’s syndrome, children with language disorders, D/HOH children, intellectually gifted children, children with mild and moderate general learning disabilities, children with attention deficit hyperactivity disorder (ADHD), children with specific learning difficulties, children with traumatic brain injury and children with motor impairment (Flanagan & Kaufman, 2004).

However, Kaufman, Flanagan, Alfonso and Mascolo (2006) state that caution must be adopted in generalising from the results of the special group studies. Small sample sizes (clinical samples ranged from 16 to 89 participants in each group) and purposive sampling, are two criticisms which are levelled at these special group studies. Kaufman et al. (2006) argue that data were derived from independent clinical settings, so that, criteria for initial diagnosis in each setting, may have been dissimilar. In addition, they also argue that the represented groups are not always

homogenous groups, with the specific learning difficulty group, for example, including children with specific difficulties in reading, written expression and mathematics.

Therefore, it is argued that information in the WISC-IV Technical Manual and Interpretative Manual (Wechsler, 2003) is not likely to be representative of a whole diagnostic class (Hebben, 2004). Therefore, although useful in describing children in terms of patterns of cognitive performance, Hebben (2004) argues that the special group studies should not be used in making differential diagnoses.

4.15.4 Reliability

Reliability refers to the “accuracy or precision of scores from a test or the degree to which test scores are free from measurement error” (Bracken & McCallum, 1998, p.98). Test reliability is demonstrated most robustly by measurement precision that is consistent across age, sex, race/ethnicity and the specific populations for which the test is intended. The reliability of the WISC-IV is demonstrated in Table 4.1 of the WISC-IV Technical and Interpretative Manual (Wechsler, 2003, p.34). Internal consistency reliability for FSIQ and composites ranges from .88 to .94 (VCI=.94; PRI=.92; WMI=.92; PSI=.88 and FSIQ=.97). Unsurprisingly, individual subtests are less internally consistent with median internal consistency coefficients ranging from .79 for Symbol Search and Cancellation to .90 for Letter-Number Sequencing. The WISC IV’s total test score (FSIQ) and index scores, therefore, offer more reliable, accurate, consistent and stable measures of cognitive functioning than do individual subtest measures on their own. This is why Watkins et al (2013, p105) have recommended that individual index scores should be used with “Caution”.

4.15.5 Test-Retest Stability

According to the WISC-IV Technical and Interpretative Manual (Wechsler, 2003), the WISC-IV scores possess adequate stability across time for each of the five age groups studied. Test-retest gains were found to be less pronounced for the Verbal Comprehension and Working Memory subtests than the Perceptual Reasoning and Processing Speed subtests. Practice effects were found to be largest for ages 6 to 7 years and became smaller with increasing age (Kaufman et al., 2006). Coding and Symbol Search showed the largest gains from test to retest for ages 6 to 7 years, while Picture Completion showed the largest gains for ages 8 to 16 years. However, it is worth noting that test-retest information was based on data from 243 children with test-retest intervals ranging substantially from 13 to 63 days. Therefore practice effects may be more pronounced for children who were retested in a shorter period of time. In addition, caution must be adopted in generalising from a sample of just 243 children.

4.15.6 G loadings

G loadings are an important indicator of the degree to which a subtest measures general intelligence (Flanagan & Kaufman, 2009). Subtest g loadings, by age groups and overall sample, are reported by Flanagan and Kaufman (Table C.1 and C.2, 2004; 2009). G loadings were reported based on two measures, the first of which assumes that **g** influences the subtests indirectly through its relationship with the four factors, the second of which assumes that each subtest has a direct relationship with **g** and a broad ability factor. Based on these methods, it is generally assumed that the VCI subtests have the highest **g** loadings at every age followed by the PRI, WMI and the PSI. In addition, Arithmetic's **g** loadings are more consistent with VCI subtest

loadings than that of Working Memory (Kaufman et al., 2006). This may have implications for substituting Arithmetic as a supplemental test in the WMI. Arithmetic has the highest g loading of .768 which is higher than Letter-Number Sequencing at .621. As Wechsler (2004, p15) advises, the Letter-Number Sequencing subtest should not be administered to D/HOH individuals. Overall, however, these results suggest that the VCI is most closely related to general ability level. This presents a difficulty when calculating the FSIQ score as Deaf and Hard of Hearing Children are more likely to have lower VCI scores than the normative population due to various factors which include: age of diagnosis, level of hearing loss, whether they have a cochlear implant and the use of sign language in the home to mention a few.

4.15.7 Item Gradients, Floors and Ceilings

“The subtests and scales of a test must have adequate range (from floor to ceiling) and appropriate difficulty gradients for the test to be valid for clinical and educational decision making at extreme score ranges” (Bracken & McCallum, 1998, p.110). The floors and ceilings of the WISC IV subtests are described as “excellent” by Kaufman et al. (2006, p.284) as scaled scores greater than 2 Standard Deviations (SDs) above and 2 SDs below the mean can be obtained on all subtests at all levels. This means that the WISC-IV^{U.K} can be useful in the identification of general learning disabilities and gifted children.

Kaufman, Flanagan, Alfonso and Mascolo (2006) describe item gradients for the WISC-IV (spacing between items on a subtest) as ranging from “good to excellent” (p.284). It is argued, therefore, that spacing between items on the WISC-IV subtests is generally “small enough to allow for reliable discrimination between individuals” (Kaufman et al., 2006, p.284) on traits measured by the subtest. However, it is worth

noting that children who obtain raw scores of 1 or 2 on each subtest have the potential to receive similar scaled scores as children who achieve higher raw scores. Therefore it may be difficult to distinguish between those children whose scores fall at the lower end of the Mild General Learning Difficulty range and those in the Moderate Learning Difficulty range by using the WISC-IV assessment. This ability range is described as “Extremely Low” in the (Interpretive manual, p101). Hence, although item gradients may be “good to excellent” the corresponding spacing between scaled scores may not be small enough to allow for reliable discrimination between children to be made. Therefore, alternative testing instruments may be more beneficial in assessing children who are functioning within the general learning disability range.

4.15.8 Validity

The validity of a test concerns what the test measures and how well it does so (Anastasi & Urbina, 1997). An examination of the test’s content and the construct it is intended to measure provides evidence about the validity of the test. The validity of a test is a fundamentally important part of test development and evaluation (Wechsler, 2003). Although structural validity for the WISC-IV is based on factor-analytic studies (as previously discussed in Section 3), information about the stability or invariance of this factor structure across age is neglected in the Technical and Interpretative Manual (Wechsler, 2003). However, the WISC-IV Technical and Interpretative Manual (Wechsler, 2003) reports that “it is expected that future use of the WISC-IV will lead to an expanding base of evidence of the scale’s validity (Ibid, p.47). Keith, Fine, Taub, Reynolds and Kranzler (2006), therefore, investigated whether the WISC-IV measured the same constructs from the ages of 6 to 16 along with the nature of the constructs. The WISC-IV standardised data was used, and

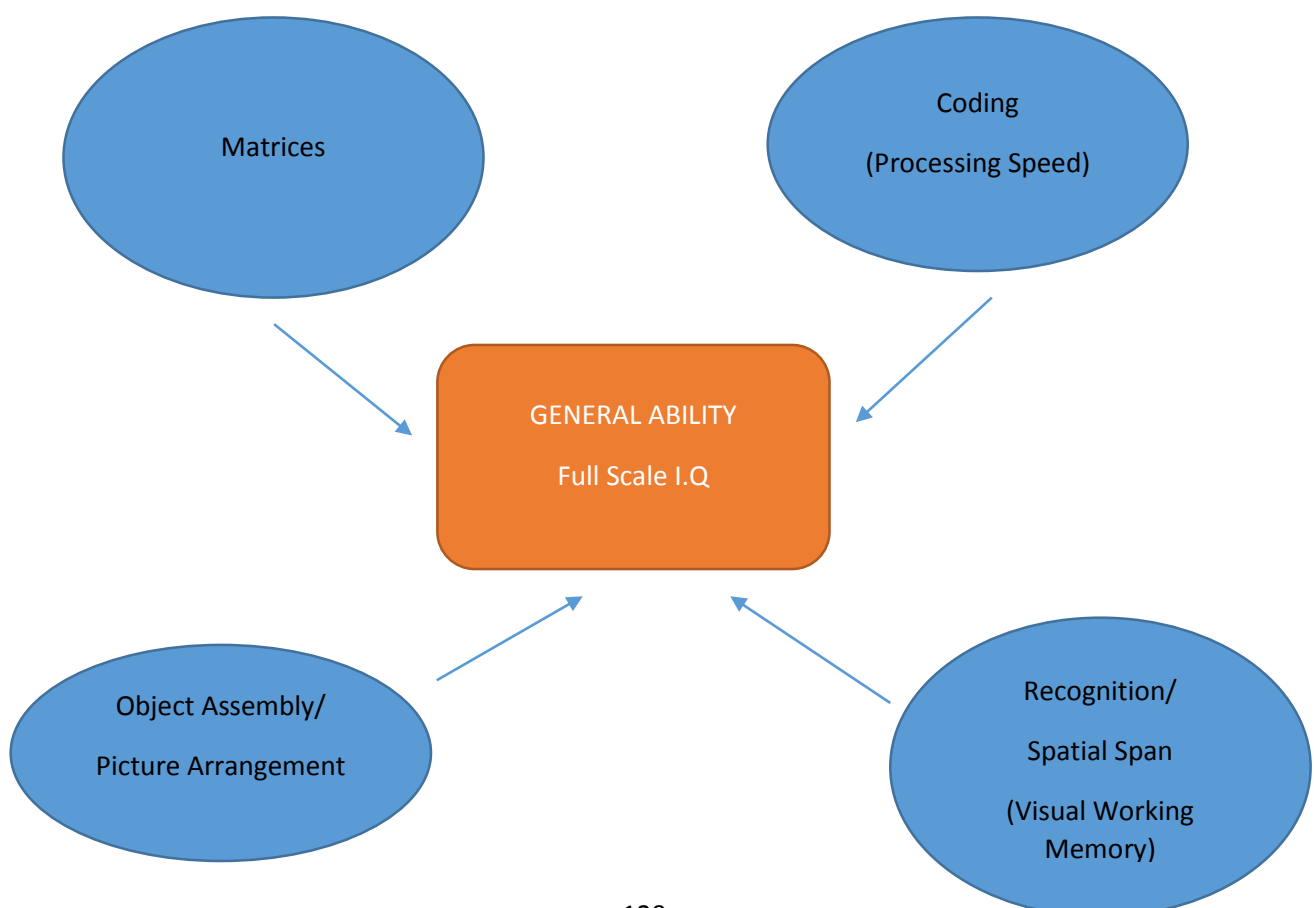
indeed, results indicated that the same constructs were being measured across the age range of the test. Keith et al. (2006), however, found that the four factor structure of the WISC-IV did not provide an adequate explanation of the constructs measured by the test and instead, promoted the five factor CHC model as a better fit to the WISC-IV standardised data (Kaufman et al., 2006). Therefore, Keith et al (2006) found five constructs underlying the WISC-IV (Gc, Gv, Gf, Gsm, Gs) as opposed to four (VCI, PRI, WM, PSI). The advantage of employing the five factor-CHC model is that it fits better with contemporary psychometric theory and research. However, as there is no correct way or method involved in factor analysis, Flanagan & Kaufman (2004; 2009) provide a comprehensive interpretative system for WISC-IV analysis, that allows analysis of performance based on both the four- and five-factor model. For this purpose, 8 new clinical clusters were developed, including fluid reasoning (Gf), visual processing (Gv), non-verbal fluid reasoning (Gf-non-verbal), verbal fluid reasoning (Gf-verbal), lexical knowledge (Gc-VL), general information (Gc-KO), long-term information (Gc-LTM) and short-term memory (Gsm-WM). Use of clinical clusters in planned clinical comparisons are discussed in Rapid Reference 4.12 (Flanagan & Kaufman, 2004, p.150), as an optional interpretative step. This is an “approach in which contemporary theory, research and measurement principles are integrated” (p.43) by developing a ‘cross-battery’ approach which is grounded in CHC theory.

4.16 The Wechsler Non Verbal Test of Ability

The Wechsler Nonverbal Scale of Ability (WNV) is an individually administered comprehensive instrument designed to measure the general cognitive ability of individuals aged 4 to 21 years. The WNV measures general cognitive ability **g** using a variety of nonverbal subtests that minimise or eliminate verbal requirements. The

WNV is commonly used when tests of verbal ability are deemed inappropriate, for example, in cases of hearing impairment, communication/language disorders and where English is a second language. Brunnert, Naglieri, & Hardy-Braz (2008) describe the WNV as a nonverbal measure of ability for anyone, regardless of the language they speak. It is not a measure of nonverbal intelligence but rather a measure of General Ability **g** using tests that do not require verbal skills. Wechsler and Naglieri (2006) have argued that all Wechsler tests have a grounding in Spearman's **g** theory and posit that there is no distinction between Verbal and Performance scales other than methodology. Bracken and Naglieri (2003, p247) also argue that "general intelligence tests with verbal content and nonverbal content measure essentially the same construct as general ability tests that are entirely nonverbal".

Figure 4B. The WNV Subtests



The WNV is composed of four subtests for children aged four to seven years, namely Matrices, Coding, Object Assembly, and Recognition. When these four subtests are combined, they yield an estimate of general cognitive ability (Full-Scale score). Subtest T scores have a mean of 50 and standard deviation of 10. The sum of the T scores from the four subtests is then used to derive the Full Scale score, which has a mean of 100 and a standard deviation of 15. For examinees aged eight to twenty-one years, the subtests of Matrices, Spatial Span, Coding and Picture Arrangement are used (See Appendix A for a description of each subtest). The WNV can be administered in an abbreviated way using two subtests, for example, examinees ages four to seven years can do the Matrices and Recognition subtests to yield a Two Test Full Scale score. Examinees aged eight to twenty-one years can take two subtests (Matrices and Spatial Span) to yield the Two Test Full Scale score.

The tests are interesting in that there is no emphasis on any type of spoken instruction: each item has a pictorial example and guide for the examinee and a series of hand signals and gestures are all that is required when administering the WNV. For a full description of reliability, validity and additional information for working with D/HOH participants please see Appendix M.

4.17. Limitations and Delimitations.

The limitations of this research are mainly due to time constraints and finance considerations. The one limitation that was unavoidable was the administration of the WISC-IV^{U.K} and the WNV on the same day. Essentially there are issues with test-retest reliability and practice effect that could not be avoided. To counteract this a simple T test was conducted to see if the administration of certain subtests such as Matrix Reasoning and certain aspects that tested Working Memory (Spatial Span/

Digit Span) showed evidence of a practice effect. Results of this assessment are outlined in Chapter Five. A clarification note on the use of Working Memory items is located in Appendix I in which the use of Digit Span and Arithmetic in the WISC-IV^{U.K} is discussed as well as comparisons between Digit Span and Spatial Span in terms of how they can be related specifically to D/HOH examinees.

One aspect of the use of interpreters also needs to be clarified and discussed. It was impossible to book the same interpreter for each assessment in that the main interpreter was only freed to work in Dublin by her employer; the Catholic Institute for Deaf People. Outside Dublin, a combination of professionally qualified interpreters and non-professionally qualified persons was used. In most cases where a non-professionally qualified interpreter was used, this was as a result of the direct preference of the examinee. In most cases, a Special Needs Assistant was used as the student preferred to work with someone they trusted and knew well. In total, six interpreters were used: a straight split between professionals and classroom helpers. Ideally, the best outcome in terms of the research, only one interpreter would have been used. However, best practice would suggest (Hardy-Braz, 2003) that the examinee should always be allowed to pick their preferred interpreter, therefore, if one is respectful to the examinee, the use of one interpreter may not be possible.

Another limitation of the research is the fact that it was impossible to use a randomly assigned group as essentially it was a self-selected population. Given that it was obviously delimited in terms of only using D/HOH students between the age of six years and sixteen years eleven months, the researcher had to rely on parents putting their child forward for participation. The exclusionary rationale was based solely on the necessity to omit D/HOH participants with co-morbid difficulties. It was essential to offer every student an assessment as numbers would be quite small to begin with

(given the school-going population of D/HOH students in specialist settings). Ideally, a larger group could have been gathered and the group could have been randomly assigned to two groups: one who first did the WNV and then the WISC-IV^{U.K} over an ascribed period of time and the other group who could have been administered the WISC-IV^{U.K} first and then the WNV over the same time frame. The researcher randomly administered the order of testing with the WNV and the WISC-IV^{U.K} in a way that equally distributed the administration of the tests on a fifty-fifty basis.

It was unfortunate that a number of students who were seventeen or over could not have been included in the research. It would have meant using three tests: the WNV, the WISC-IV^{U.K} and the WAIS-IV (The Wechsler Adult Intelligence Scale) thus complicating the data. Certainly had there been more time available to the researcher it would have made for a wider scope for the topic and it is something that the researcher would be open to should the opportunity present itself in the future.

Delimitations include the exclusion of hearing students, D/HOH students who presented with co-morbid conditions, children under the age of six and adults over the age of seventeen years.

4.18. Reflexive Thinking.

As an educational psychologist, the researcher is accustomed to dealing with the power differentials that are a factor in the psycho-educational assessment process. In Ireland, schools refer children who are presenting with difficulties to the educational psychologist. In essence then, students are seen as “failing” in the system and parents/guardians are informed that an outside “expert” will assess the child and come up with a “diagnosis” of the difficulty and a list of recommendations

that should be followed. In the past, educational psychologists were seen as “gatekeepers” to resources for students who needed extra help in the form of additional support teaching hours or indeed the support of a special needs assistant. However, with the establishment of the National Council for Special Education (NCSE) in 2005, this “gatekeeping” role was taken over by Special Education Needs Organisers (SENO's) employed by the NCSE.

Educational psychologists are still perceived as having a lot of influence and power by schools in that they are short in supply and the demand for psychological interventions for individual students always exceeds the supply of educational psychologists' time. Parents/guardians are often disempowered by schools in this situation as the child is often seen as having a problem. The school system rarely sees itself as having a problem or being to blame for student failure. The additional weight of an outsider coming from the Department of Education and Skills to “assess” the child can often be seen to legitimise the position of the school. Bearing in mind that parents and guardians cannot refer a student to the psychological service, obvious imbalances in power can exist.

The researcher was keen to avoid this difficulty in power imbalance and so endeavoured to be as inclusive as possible and to encourage parents and guardians to refer the child themselves. An invitation was issued via the websites of Deafhear.ie, The Catholic Institute for Deaf People and through contact with the organisation Sharing the Journey which had been set-up by parents of D/HOH children. It would have been easier to ask the special deaf schools for access to their students and the researcher was aware that greater numbers of participants would have been involved, however, it was necessary to distance the normal practice of

working as an educational psychologist for the National Educational Psychological Service from the role of researcher.

Parents and guardians referred students to the researcher and signed an “expression of interest” document (see Appendix J) as an initial way of showing an interest. The reason why the Expression of Interest document was used was to differentiate the way parents and guardians were normally treated by schools and NEPS: they were usually asked to sign a legal consent form prior to meeting the psychologist which again can be disempowering as they do not have a chance to ask questions or clarify concerns.

Parents and guardians were contacted by e-mail, by text or by phone and an informed consent meeting was organised with the option of their preferred interpreter. What was interesting was the large number of participants who were happy to use the interpreter provided by the researcher rather than opting for an interpreter that they might have preferred. Some participants shared that once they had been consulted around this preference, they were happy to go with the interpreter supplied by the researcher.

In one case, a parent insisted that they would sign for their child but this provided a difficulty as it was believed that some ethical and validity issues would arise from this situation. In the end, the child decided on two occasions that they did not want to participate and the issue was avoided. The young participants were all present during the informed consent meeting and were encouraged to ask questions, to express their opinion and to sign the consent form along with the adult accompanying them. The pros and cons of having the assessment were discussed and the difference between the two tests was illustrated. It was only on the day of the

testing that true informed consent was obtained. Another attempt to give power back to the participants and their parents/guardians was the definition of ownership of their feedback documentation: it was clarified that the feedback documents were the property of the child, their parents/guardians and the researcher.

The researcher explained how this information would be kept secret in a locked filing cabinet and that there was no way that their information could be seen by anyone else. The information used would have all identifying information deleted and separated so that it could never be linked back to them.

4.19. Summary.

This chapter has outlined the research objective, rationale, design and identifies the challenges experienced during the gathering of information. It also identifies a way of gathering information that attempted to be as inclusive, respectful and sensitive to the participants as possible.

There are sections that describe the materials used and the validity, reliability and importance of the cognitive tests selected and used. Methods of data analysis such as thematic analysis and statistical analysis are described as well as a justification for their use. The following chapter will now address the results obtained and provide an analysis of how this information might be interpreted.

Chapter Five:

This chapter is presented in three parts: the first section (5.1) will report the findings from the statistical analysis of the results of the cognitive testing of the sample population. Section 5.2 will identify the main themes that emerged from the thematic analysis of the semi-structured interviews held with the participants after the cognitive testing process. Section 5.3 will identify the main challenges that occurred when using an Irish sign Language translator to administer the first cognitive test, the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV^{U.K})

5.1. Statistical Analysis of data gathered from cognitive testing.

As outlined in the Methods chapter, the main focus of this research was the investigation of results gathered from the administration of two cognitive tests: the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV^{U.K}) and the Wechsler Nonverbal Scale of Ability (WNV). The research question centred on the difference between the two tests and the administration of the WISC-IV^{U.K} through Irish Sign language (ISL) using an interpreter. The researcher proposed that the WISC-IV^{U.K} results would be significantly lower than those of the WNV for each participant due to the language demands of the instructions and the inclusion of tests which assessed Verbal Comprehension. As outlined in the literature review in Chapter Two, the late acquisition of language due to delayed identification of hearing impairment results in poor levels of language ability in D/HOH children. The average age of identification of hearing impairment in this sample was over three years of age which suggests that the children who participated in this study may have experienced language delay and impoverished language acquisition. As a result of this challenge, it was theorised that tests of cognitive ability that utilised language

components and which administered instructions through language would impact severely on the D/HOH's participant's ability to perform well. It was theorised that the overall mean of performances would be below the average range for this test (I.Q standard scores from 90-109 are within the average range)

The WNV was administered without any language input or the use of an interpreter. The test was specifically designed with the D/HOH population in mind and it was theorised that participants would produce scores which would be within the average range of 90-109 standard score. Furthermore, the research addressed the traditional use of the Perceptual Reasoning Index score of the WISC-IV^{U.K} by psychologists to report the non-verbal reasoning ability of D/HOH students. It was theorised that scores produced by participants would be, on average, lower than scores on the WNV due to the language loading of the instructions. Scores were expected to be higher for the Perceptual Reasoning Index than that of the Verbal Comprehension Index but lower than the mean scores for the WNV.

The WNV can be administered in a short or long form. The short form has two tests which are administered to evaluate Non Verbal reasoning and Working Memory. The longer form is comprised of the first two tests from the short form plus a Coding test (measuring Processing Speed) and a test of Picture Arrangement (measuring fluid reasoning) or Object Assembly for children under seven years and eleven months. In theory, the test and the four subtests are administered non-verbally and require no language to answer from the participant. However, it was theorised that the Picture Arrangement subtest *may* involve some use of language. The test involves pictures that are placed in front of the participant and the participant is required to put the pictures in order to make a sequence that makes sense. For example the second sample administered to participants has four pictures: a boy walking, a boy placing a

wooden plank over a small stream, a boy walking away on the other side of the stream and a boy thinking about how he is going to cross the stream. The participant must place the pictures in order showing the boy walking, thinking about how to get across the stream, placing the wooden board across the stream and lastly, walking away on the other side of the stream.

It is suggested by the author that this problem solving test *may* actually involve the use of language in that a “Story” is being told by the four pictures: as with all the other items in Picture Arrangement. As all four tests were administered to each participant, it was possible to compare the use of the four test scores with the two test scores for each participant. In theory, both scores should be equal in terms of standard scores but it is possible that the use of “language” in Picture Arrangement may suppress scoring in each individual as theorised in the WISC-IV^{U.K.}. A comparison of these scores was also calculated to investigate this hypothesis. Therefore, statistical analysis was used to investigate the following hypotheses:

(1) That there will be a significant statistical difference between the overall mean scores in individual and group performances in the WISC-IV^{U.K.} and the WNV four test score. The hypothesis is that there will be higher mean standard scores on the WNV than the WISC-IV^{U.K.} due to the inclusion of Language testing in the Verbal Comprehension Index and the use of language-laden instructions throughout the test administration.

(2) That there will be a significant statistical difference between scores on the Verbal Comprehension Index and the Perceptual Reasoning Indices of the WISC-IV^{U.K.}. The hypothesis is that there will be a significant difference between the performances on these two Indices with a higher score predicted on the

Perceptual Reasoning Index. Again, the prediction is based on the theorised delay in language acquisition in the D/HOH participants. Due to this delay, it is proposed that participants will score significantly lower in the Verbal Comprehension Index score than the Perceptual Reasoning Index score.

(3) That there will be a significant statistical difference between the individual mean scores of the Perceptual Reasoning Index of the WISC-IV^{U.K} and the individual mean scores of the WNV (Four-Test). Traditionally, psychologists have used the Perceptual Reasoning Index score of the WISC-IV^{U.K} as a summative non-verbal I.Q for D/HOH students. However, it is theorised that the language-laden instructions involved in the administration of the three subtests that form the Perceptual Reasoning Index (Block Design, Matrix Reasoning and Picture Concepts) will result in underperformance in these cognitive tasks. The hypothesis is that the individual and mean scores in the Perceptual Reasoning Index of the WISC-IV^{U.K} will be significantly lower than those of the WNV (four test).

(4) That there will be a statistically significant difference between individual scores in the WNV Two Test score and the WNV Four Test score in D/HOH children older than eight years of age. It is hypothesised that there may be a language aspect of the Picture Arrangement subtest in the eight years to twenty one years and eleven months section of the WNV. This test will investigate whether there is a statistical difference between the four and two test versions of the WNV administered to D/HOH participants over the age of eight. The age of eight is used for the introduction of the Picture Arrangement test in the WNV.

(5) A further investigation of the data was carried out to test whether there was a significant statistical difference between the two tests of short term Working Memory used in the WISC-IV^{U.K} and the WNV. The test used on the WISC-IV^{U.K} involved the use of ISL to sign lists of numbers that had to be relayed back to the administrator. Essentially this test is an auditory test which is administered to hearing individuals: numbers are called out by the administrator and the participant has to remember these numbers and repeat them back orally when the administrator has finished calling out the numbers. This research used an interpreter to “sign” the numbers and the D/HOH participant was requested to sign back what they had “seen”. This means that an auditory short term working memory test was turned into a visual short term working memory test. The test of short term working memory in the WNV involved the use of Corsi Blocks: a test of short term visual memory. It was hypothesised that there may not be a significant statistical difference between the scores obtained by participants in both tests as they were used to test the same construct: short term visual memory: an aspect of Short Term Working Memory.

(6) Finally, the administration of two tests called Matrix Reasoning was investigated to see if there was any evidence of a practice effect.

5.1.1 Clarification regarding the use of specific tests in SPSS 20.

The initial analysis of the data had attempted to incorporate an analysis of variance (ANOVA) as it was believed to be a more sophisticated tool to analyse the data (Pallant, 2013, p285, Dancey and Reidy, 2004, P292). An analysis of variance tests whether there are main effects for each of the independent variables and whether the interaction between the variables are significant. This test not only measures

difference between mean scores in a within subject design, it also measures the difference between each individual score. However, in discussion with Dr. James J. Walsh (University of East London) there was a difficulty identified with this approach: the scores for the Perceptual Reasoning Index are part of the Full Scale I.Q (FSIQ) on the WISC-IV^{u.k} and thus they are not technically an independent variable which means that an ANOVA would be the incorrect calculation to carry out. Likewise for the Two Test and Four Test scores on the WNV. They are not independent of each other and thus it was agreed that a Paired Simple T-Test would be carried out to compare means between participants.

5.1.2 Findings.

Hypothesis 1: *That there will be a significant statistical difference between the overall mean scores in individual and group performances in the WISC-IV^{U.K} and the WNV four test score*

The first test, using the SPSS statistical package, was carried out was to compare the means of the FSIQ WISC-IV^{u.k} and the WNV Four Test. The mean of the WISC-IV^{u.k} was calculated as 74.77 with a standard deviation of 19.682, skewness of .505, and standard error of .821 (see Table 4.1)

Table 5.1 Mean Scores for WISC-IV UK (N=31)

			Statistic.	Std. Error
Full scale IQ using WISC	Mean		74.77	3.535
	95% confidence Interval for Mean	Upper Bound	81.99	
		Lower Bound	67.55	
	Median		74	
	Variance		387.381	
	Std. Deviation		19.682	
	Skewness		.505	.421
	Kurtosis		.808	.821

A histogram was produced to show the skewed nature of the results. The mean for the WISC-IV^{U.K.} should be 100 whereas the results for the D/HOH population indicate a mean skewed to the left at 74.77.

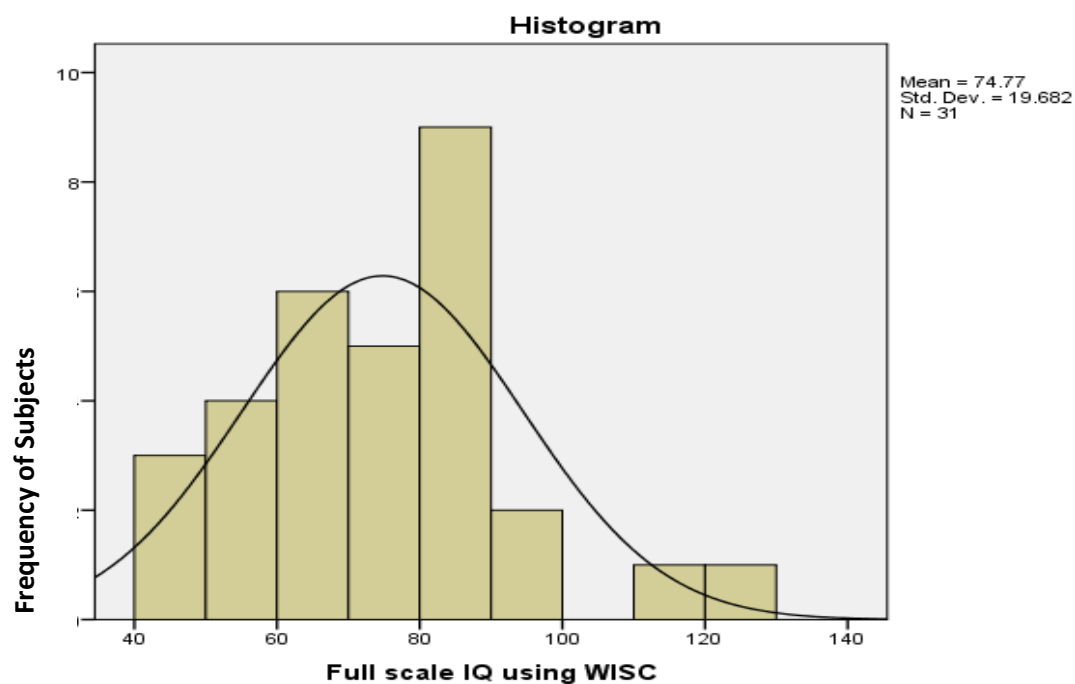


Figure 5.2 Histogram of WISC- IV^{U.K.}

When one compares this to the mean of the WNV it is quite evident that the WISC-IV^{U.K} produces a lower mean (see figure 5.2 and 5.3)

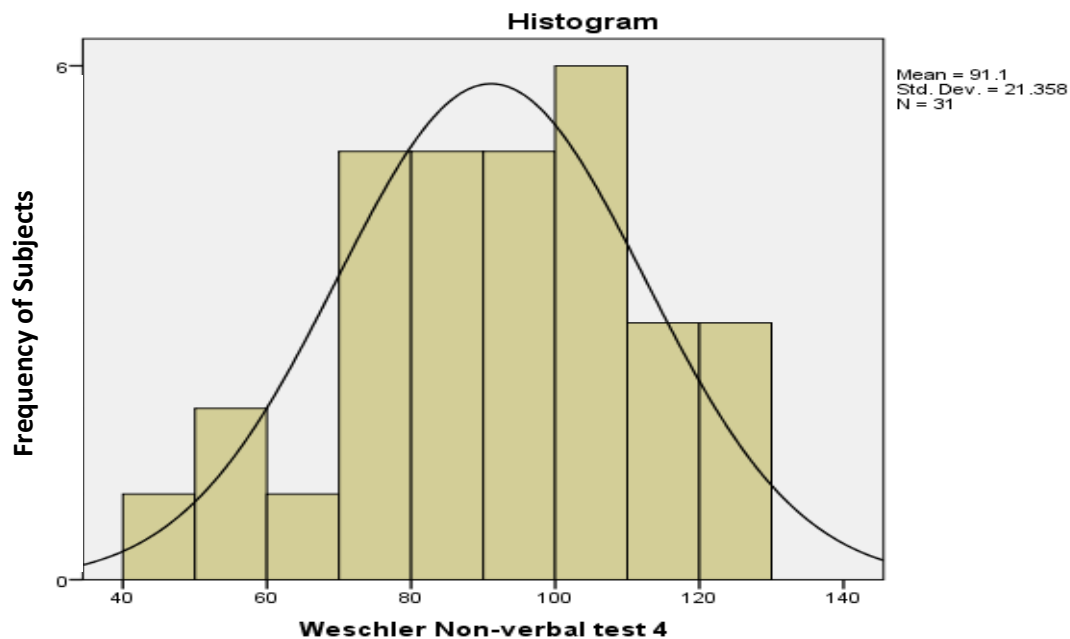


Figure 5.3 Histogram of the WNV Four Score

The mean score for the WNV Four Test is 91.1 with a standard deviation of 21.358 which indicates a difference of 16.33 of a standard score between the WISC-IV^{U.K} and the WNV Four Test Scores.

A Paired-Samples t-test was conducted to evaluate the difference in the means between the WISC-IV^{U.K} and the WNV Four Test. There was a statistically significant difference between the two scores: WISC-IV^{U.K} Full Scale I.Q, M=74.77, SD19.682 and WNV Four Score, M91.10, SD 21.358. The difference is significant at $P < .001$.

Table 5.2 Means, Standard deviations and Standard error mean of Full Scale I.Q (WISC-IV^{U.K.}) and WNV Four-Test scores.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Full scale IQ	74.77	31	19.682	3.535
	using WISC				
	Wechsler	91.10	31	21.358	3.836
	Nonverbal				
	4 Test				

The t value is calculated at -8.332, df =30. This would indicate that there is a highly significant difference between the two sets of scores produced by the same participants. An effect size for the use of ISL in the WISC-IV^{U.K.} was calculated using Cohen (1988, pp284-7) and the results indicate a large effect (-0.808). We can conclude that there was a large effect, with a substantial difference in the two mean scores used. The null hypothesis can be rejected for this hypothesis.

5.1.3. Comparison between the Perceptual Reasoning Index and the WNV Four-test.

Hypothesis 2: *That there will be a significant statistical difference between scores on the Verbal Comprehension Index and the Perceptual Reasoning Index of the WISC-IV^{U.K.}*

Table 5.3 Means, Standard Deviations and Standard Error Means of WISC-IV^{U.K} PRI and WISC-IV^{U.K} VCI.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	WISC PRI	86.6129	31	18.00496	3.23379
	WISC VCI	67.8387	31	20.31928	3.64945

Table 5.4 t-test comparing WISC-IV^{U.K} PRI and VCI

Paired Samples Test

Pair 1	Paired Differences								Std. 2-tailed
WISC/PRI	Mean	Std.	Std.	95% Confidence					
WISC/VCI		Deviation	Error	Interval of the					
			Mean	Difference					
				Lower	Upper	t	df		
	18.77419	18.0475	3.2414	12.15430	25.3940	5.792	30		.000

A Paired-Samples t-test was conducted to evaluate the difference in mean scores between the Perceptual Reasoning Index of the WISC-IV^{U.K} and the Verbal Comprehension Index of the WISC-IV^{U.K}. There was a statistically significant difference between the two Index mean scores: VCI WISC-IV^{U.K} M=67.838, SD=18.004 and the PRI WISC-IV^{U.K} M=86.613, SD=20.319, $t(30) = 5.792$, $p < .001$, confidence interval ranging from 12.15 to 25.39. This result indicates that there is a significant difference between the WISC-IV^{U.K} Index mean scores of the Verbal

Comprehension Index (VCI) and the Perceptual Reasoning Index (PRI) in favour of the PRI. This indicates the predicted significant difference between the Index scores due to language delay. The null hypothesis can be rejected.

5.1.4.

Hypothesis 3: *That there will be a significant statistical difference between the individual mean scores of the Perceptual Reasoning Index of the WISC-IV^{U.K} and the individual mean scores of the WNV (Four Test)*

This comparison was used to compare the traditional method used by educational psychologists to assess the I.Q of D/HOH children (The Perceptual Reasoning Index) with the results of the WNV Four Test. A paired simple t-test was calculated to evaluate the difference between the PRI Index of the WISC-IV^{U.K} and the WNV Four Test mean score.

Table 5.4 Means, Standard Deviations and Standard Error Means of WISC-IV^{U.K} PRI and WNV Four-Test scores.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Perceptual Reasoning Index	86.61	31	18.005	3.234
	Wechsler Non-verbal 4 Test	91.10	31	21.358	3.836

Table 5.5 t-test comparing WISC-IV^{U.K} PRI and WNV Four-Test scores.

Pair 1	Paired Differences						Std. 2-tailed	
Perceptual Reasoning Index-Wechsler Nonverbal 4 Test	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference		t	df	
	-4.84	10.914	1.960	-8.487	-4.80	-2.287	30	.0290

The reported t value of -2.289 is significant when calculated at a one-tailed P value of .0145. The results would suggest that there is a significant difference between the mean scores of each test. This would suggest that there is some verbal loading in the administration of the WISC-IV^{U.K} which may impact on the D/HOH participant's performances. It could be argued that using ISL on a "non-verbal" index of the WISC-IV^{U.K} impacts on the D/HOH person's ability to perform on this test. The Effect Size was calculated for the difference between the PRI and the WNV Four Test. Cohen's d was reported as -0.231. This result indicates a "small effect size" (Pallant, 2013, p256). Hence we cannot argue that the use of ISL influenced the lower mean score on the WISC-IV^{U.K}. Given that the PRI is often reported as a non-verbal I.Q and traditionally used by educational psychologists, it cannot be reported that the use of ISL negatively effects the D/HOH person's performance on the PRI index. This may explain why the Perceptual Reasoning is often used by educational psychologists in general as a measure of non-verbal ability. However, we must also note that the test is administered via verbal or signed instructions and therefore is not specifically a "Non-verbal" test of ability but rather a test of fluid reasoning (McCallum, Bracken

and Wasserman, 2001, pp16-17). The reported significant difference between the mean scores on the WISC-IV^{U.K.} and the WNV could be more a verbal loading factor rather than the use of sign language.

5.1.5. Comparison of the WNV Four-test and the WNV Two-test.

Hypothesis 4: *That there will be a statistically significant difference between individual scores in the WNV Two Test score and the WNV Four Test score in D/HOH children older than eight years of age.*

One of the research questions raised in Chapter Two involved an analysis of the use of Picture Arrangement in the Four Test index of the WNV. It was posited that, perhaps there was an element of language loading in the Picture Arrangement subtest that might hinder D/HOH participants. A comparison of the Two Test (which does not have Picture Arrangement) with the Four Test scores was carried out.

Table 5.6 Means, Standard deviations and Standard Error Means of WNV Four-Test and WNV Two-Test.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Wechsler 4 Test	91.10	31	21.358	3.836
	Wechsler Non-verbal 2 Test	92.39	31	16.940	3.042

Table 5.7. Correlation between WNV Four-Test and WNV Two-Test.

		Paired Samples Correlations		
		N	Correlation	Sig.
Pair 1	Wechsler Nonverbal 4 Test & Wechsler Nonverbal 2 Test	31	.922	.000

One can see that there is a very high correlation between the two tests of .922.

Table 5.8. T-test of differences in means of WNV Four-Test and WNV Two-Test.

Pair 1	Paired Differences						Std. 2- tailed	
Wechsler Non-verbal 4 Test Wechsler Nonverbal 2 Test	Mean	Std.	Std.	95% Confidence				
		Deviation	Error	Interval of the				
			Mean	Difference				
				Lower	Upper	t	df	
	1.290	8.722	1.567	-4.490	1.909	-.824	30	.417

This result indicates that there is no significant difference between the WNV Four Test and the Two Test and suggests that any language loading in the Picture Arrangement subtest is quite low. While a participant has a slightly better change of scoring higher in the Two Test index of the WNV, the difference is not significant. Compared to the WISC-IV^{U.K.}, there does not seem to be any language loading on the WNV Four Test. Therefore the null hypothesis cannot be rejected.

5.1.6 Investigation into Short Term Working Memory.

Further investigation was carried out to calculate the difference between three Short-Term Working Memory tests administered in the research. In the WISC-IV^{U.K.}, Digit-

Span and Arithmetic are subtests used to calculate the Working Memory Index while the Corsi Blocks is a measure of Short-Term Working Memory in the WNV. One of the questions which arose out of the Literature Review centred on the use of sign language for the WISC-IV^{U.K} tests as they are essentially tests of auditory memory. Translating combinations of numbers from an auditory input to a visual input may impact on the “space” available for Short-Term Working Memory (which usually spans 4-6 seconds see Baddeley and Hitch, 1974). It was posited that there may indeed be a difference between Digit-Span and the Corsi Block performances of the participants as visual memory is a known skill in D/HOH individuals (Todman and Seedhouse, 1994).

Again, the question is linked to the research question which asks “is it possible to use tests like the WISC-IV^{U.K} by simply administering them through sign language?”

It has been argued earlier that using sign language to alter what is essentially an auditory test will have a negative effect on the D/HOH person’s performance.

A one-way repeated measures ANOVA was conducted to compare scores on Short-Term Working Memory over three tests: Digit-Span, Arithmetic and Corsi Blocks. The means and standard deviations are presented in Table 5.10 one page 142.

Table 5.9. Means, Standard Deviations and Number of Participants in Three Working Memory tests.

	Mean	Std. Deviation	N
WISC-IV ^{U.K} Digit-Span	76.6129	16.55230	31
WISC-IV ^{U.K} Arithmetic	76.6129	14.51362	31
WNV Recognition/Spatial Span	94.5161	19.90791	31

On viewing the results of the tests of the two WISC-IV^{U.K} Working Memory Tests (Digit-Span and Arithmetic) one can see that there is a gap of 17.9 in standard scores. Interestingly, the mean scores of the two WISC-IV^{U.K} Working Memory Scores are identical at 76.

The results of the one-way repeated measures ANOVA show a significant difference on the three performances in favour of the WNV Corsi Blocks (See table 4.12 and 4.13 below). Wilks Lambda= .459, $F(2, 29) = 17.08$, $p < .001$, multivariate partial eta squared = .541. This suggests that there is a very large statistical difference between the three scores in favour of the WNV Four Test scores for D/HOH participants. The reduced mean scores is indicative of the results produced earlier when ISL was used to administer tests on the WISC-IV^{U.K}. The use of visual stimuli on an auditory test inhibits performance when compared to a test designed for visual memory (Corsi Blocks). Again, as with other tests on the WISC-IV^{U.K} the use of sign language actually impairs performance rather than supporting it for D/HOH individuals.

Table 5.10. Pairwise Comparisons. Comparing the three Working Memory Tests to each other. Condition 1 = Digit-Span, Condition 2 = Arithmetic and Condition 3 = WNV Corsi Blocks.

Measure: Working Memory

STWM	STWM	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
1	2	.000	1.704	1.000	-4.321	4.321
	3	-17.903*	3.081	.000	-25.717	-10.089
2	1	.000	1.704	1.000	-4.321	4.321
	3	-17.903*	3.189	.000	-25.991	-9.816
3	1	17.903*	3.081	.000	10.089	25.717
	2	17.903*	3.189	.000	9.816	25.991

Based on estimated marginal means

- *. The mean difference is significant at the .05 level.
- b. Adjustment for multiple comparisons: Bonferroni.

Results show that there is no significant difference between the WISC-IV^{U.K} Digit-Span and Arithmetic while there is a significant difference between the WNV Corsi Blocks and both WISC-IV^{U.K} measures.

5.1.7. Summary.

From the results shown above, it is clear that there is a significant difference between administering the WISC-IV^{U.K} through sign language and the administering of a purely non-verbal intelligence test. Whether the comparison is between the Full Scale I.Q scores produced in the WISC-IV^{U.K} or using the traditional measure of non-verbal intelligence of the PRI, we can see that both estimates of cognitive ability significantly underestimate the abilities of D/HOH participants in this research.

The WNV non-verbal tests, whether it be in Four or Two Test format produce mean scores significantly higher than the WISC-IV^{U.K} administered through ISL. The question of whether there was an aspect of language in the Picture Arrangement subtest of the WNV was addressed and rejected. While participants might score marginally better when not doing the Picture Arrangement subtest, there is no significant difference between the two sets of scores. The hypotheses that addressed the issue of using sign language to administer cognitive tests have all been proven and it is clear that using sign language to administer cognitive tests produces significantly lower scores in the D/HOH sample who participated in this research. The next section will report on the results of the semi-structured interviews that were held with the participants after the cognitive tests were administered. We

will see how they experienced the tests and whether they had a preference for one particular test.

5.2 Exploration of Semi-Structured Interviews.

A full transcription of the individual answers to the semi-structured questions is presented in Appendix I. This section will attempt to analyse and offer a commentary on the types of responses given by the individual participants. The interviews were held at the end of the psychometric testing (IQ testing) and were in the presence of the interpreter. The structure was open-ended and allowed for the participants to respond in a way that facilitated a conversational approach.

5.2.1. Question 1.

The first question asked “What did you think about the tests?” Most responses were positive in nature while acknowledging the fact that some of the subtests were challenging. For example, one participant answered “They were good fun and I enjoyed doing them. Some of them were hard but I did my best” (Appendix K, line 3).

One participant felt that the tests were too challenging: “I did not like doing them. They were too hard” (Line, 12). Some follow-up questions were asked to clarify which parts of the test were “Hard” and in all instances the WISC-IV^{U.K} was identified as the hardest test for the participants. This was to be expected as, in every instance, the participants scored lowest in the WISC-IV^{U.K} and therefore would have found that particular test challenging. When the participants identified the WNV as the test they enjoyed doing, they had expressed a good experience of the testing process. This again is to be expected as they had not only found the test that focused on individual strengths (Visual Working Memory) but also that the test was quick and easy to finish.

5.2.2. Question 2.

This question asked “Which one did you prefer doing?” and has mostly been answered by the participants in the first question. The vast majority of the participants preferred the WNV (twenty two in total). The reasons given for this preference involved the absence of sign language and the fact that the interpreter was not present. One participant summed this up as “I liked the shorter one where there was just you and me” (Line 3).

However, nine participants expressed a preference for the WISC-IV^{U.K} test. The reasons given for this varied from “I learnt new words from Amanda (Interpreter, line 12) to “I preferred using the one where I signed because I need sign language to understand how to do the tests” (line 13). It was clear that some of the participants had the kind of personality that liked a challenge: they liked the fact that it was harder and that they were challenged: one participant even stated that “The other one was too easy” (line 11). Here we have a combination of participants who enjoyed a challenge alongside others who enjoyed the success of the shorter WNV which was less challenging and thus, to them, was more enjoyable.

5.2.3. Question 3.

This question asked participants whether they enjoyed doing any particular subtest. What was interesting in the responses to this question was that the vast majority of the participants preferred doing subtests that involved visual processing and visual memory: “I liked the picture one. I liked the one where the dog chased the man. I have a dog and he does that” (line 2) and “The Blocks where I had to remember, I liked that” (Line 1). As identified in the work of Braden (1994), D/HOH individuals present with superior visual processing skills and have a clear preference for visual-

perception tests as sign language utilised these skills. Not one participant identified a language-based subtest as a favourite which might be expected as these tests proved to be very challenging to participants in general.

5.2.4. Question 4.

Question four asked the participants to explain the reason why they chose a particular subtest in question three. Most (sixteen) identified the test because it was easy and fun to do: “I am good (at it) and it’s easy” (line 4) and “It was easy and fun cos you tried to make me forget” (line 5). What was interesting about the responses to this question was the identification of an element of language present in the WNV Picture Arrangement: “I like telling the story and I could change it” (Line 9) and “I like the story-some were funny” (line 10). While there is an element of story-telling in this subtest, there is no evidence that participants scored lower in the WNV as a result of this (see results section). Four answers focused on the challenge of the test as a reason for their choice: “It was a good challenge and I liked getting the answers” (Line 21).

There was some reference to the challenge of the test that used language: “I didn’t have to sign. I prefer not to sign as it is hard when I am thinking two things”. This answer related directly to the work of Marschark, Leigh, Sapere, Burnham, Convertino, Stinson, Knoors, Vervloed, and Noble, (2006) who identified the issue of using interpreters while students were being instructed by a teacher. Clearly, focusing on an interpreter while trying to look at an examiner and trying to understand what one is being asked is very challenging.

5.2.5. Question 5.

This question asked participants to identify traits that makes a person “Intelligent or clever”.

It would seem that the majority of the participants in this sample (twenty five) identified being intelligent with school-based learning or academic ability. This level of response would suggest that, as school-going student, they would associate intelligence with learning and academic ability: “Someone who is clever is good at school and gets answers right” (line 1) and “I think a person who is intelligent is great at school and gets all their homework right” (3).

A total of five participants identified being clever with interpersonal skills: “They would be good with people and be able to help others” (line 18) and “They would be good at most things. Not only school but with people too. You have to be good with people or there is no point in being intelligent” (line 20). This kind of response is linked to the idea of emotional intelligence which is discussed in Appendix C.

5.2.6. Question 6.

Question six asked participants to list personal traits of a clever or intelligent person. Again, as with question five, participants identified personal traits such as academic ability: “It means I can learn things quickly like maths” (Line 1) and “I am good at tests you gave me and am good at school” (Line 5). Some participants identified interpersonal skills such as getting on with other people: “You would say that I am nice to people” (line 13) and “I help others in my class” (line, 10). Interestingly, four participants responded by refuting that they were intelligent: “I am not intelligent. I am not good at reading and I cannot sign words that others know” (Line, 17). This response came from a second level student who had been in mainstream education

but had transferred to a special school for the Deaf. Another participant also noted that they were not clever as they had difficulties with academic skills: “I am not clever as I do not read well. I am no good at that” (Line 18).

5.2.7. Question 7.

This question asked participants to identify actions or behaviours that showed intelligence in a person. Again, as with earlier questions, participants identified academic performance with being intelligent or clever. Twenty-three participants responded with a link to academic performance: “I got my spelling right and my maths right” (line 4) and “I am good at school and work hard all the time” (Line 2).

Five participants linked this ability with the concept of helping others; “I am good with my friends. I listen and they tell me things about their problems and I help” (Line 14). Others stated that they help out at home; “I help my little brother and my mammy at home and I am good at that. My mammy says I am a great girl” (line 12). While the majority of the responses indicated that academic ability was a key aspect of intelligence or “being clever”, it is interesting to note that some responses linked this ability to being kind and helping others.

5.2.8. Question 8.

This question asked the participants to identify behaviour that was not “clever” or “Intelligent”. There was a clear majority of responses that linked this question with academic underperformance: “They could not read” (line 3, 1 and 4) and not good at English: “No good at English and make lots of mistakes” (line 5). A number of participants identified a lack of effort or “trying” as a sign of lack of intelligence: “They do not work and do not try in school” (Line 8) and “Dumb, doing nothing in school and not learning. Too laid back and not working” (Line 9).

Some responses identified certain behaviours such as being “selfish” (Line 11), being “Bold” (line 12) and even “Messy” (line 13).

5.2.9 Summary

It is clear that the majority of the participants linked or associated the concept of Intelligence with academic school-based skills, especially reading and maths. A small minority referred specifically to Emotional Intelligence skills such as being friendly, helping others and being kind. These tended to be older children who perhaps had more maturity or different perspectives.

The majority of the participants preferred the WNV test as it was administered by the researcher without the use of an interpreter or ISL. Tests that used visual perceptual skills were preferred by participants and it is clear that participants did not enjoy either doing tests that involved language testing or were challenging. However, some participants reported preferring tests that challenged them. While the interviews were relatively short, they provided the researcher with information around preferred learning styles, the challenges of the WISC-IV^{U.K} in terms of the language loading and it provided the researcher with an overview of how intelligence is perceived amongst the participants. It illustrated that the participants were aware of abilities beyond academic and school-based skills and indicated an understanding of emotional Intelligence without specifically referring to the concept. It is clear that the participants enjoyed the challenge of the tests, liked doing well and had a preferred visual learning style which is quite common and therefore indicate that the participants were not different than their hearing counterparts in schools.

5.3 The use of interpreters and administering tests through ISL.

The WISC-IV^{U.K} was administered through Irish Sign Language (ISL) with the aid of an interpreter. It became apparent from the very first meeting that there were issues around using ISL to “translate” verbal components of the WISC-IV^{U.K}. A discussion between the researcher and the interpreter outlined the difference between *translating* and *interpreting*. The researcher requested that all verbal components were translated exactly as spoken which would have required the use of Signed English. The interpreter suggested that we would not be actually using the participants’ actual language if Signed English was utilised. ISL is the primary communication mode of D/HOH individuals and they do not use Signed English except perhaps in English lessons in school. The research investigated the use of ISL in administering a cognitive test to D/HOH and therefore it must be stated that the administering of this test was an **interpretation** of the verbal components of the WISC-IV^{U.K}.

Some examples of using ISL as opposed to Signed English might enlighten the reader. ISL is essentially a communication tool that is pragmatic: the aim is to convey meaning and to keep the conversation flowing and fluid. If a D/HOH individual wanted to ask “Would you like to go shopping with me later?” it would be signed in part with hand gestures (“You” “me” Shop” Later”) and in part with facial expressions (frown indicating questioning). “I was very angry” would be signed as “I+angry” and facial expressions indicating the level of anger involved by the facial expression.

This mode of communication was used to truncate sentences from the WISC-IV^{U.K} such as “What would you do if you see thick smoke coming from the window of your

neighbour's house?" (From the Comprehension Subtest of the Verbal Comprehension Index). This was translated into ISL as "you+home+look+see fire. What you do?". "What are the advantages of exercising and being active?" (Comprehension as above) is translated as "What+good+exercising?"

It became apparent during the testing period that some of the interpreters were not translating exactly what the participant was signing. This was not an issue with the main translator as this was discussed thoroughly prior to testing. Outside of Dublin City interpreters had to be hired through agencies or by using personal communicators in the school itself. An aspect of D/HOH culture is that individuals must be asked if they had a preferred communicator. On virtually every occasion the interpreter supplied by the researcher was acceptable to the participant and their parent. Only on one occasion did the parent of the participant insist that they communicate for their child.

As previously stated, the researcher noted that some interpreters were not supplying answers as supplied by the participant. An element of the interpreter "Interpreting" what was answered was noted which led to a request to "just say what the participant signs and nothing else". Often, answers were not fully elaborated and would not have scored full points but the interpreter attempted to state what the participant "meant" rather than what they said. This practice was discussed with the interpreter and an agreement was reached around translating what was signed rather than "interpreting" what was signed.

It was decided with the main interpreter that the Working Memory Index subtest of Letter-Number Sequencing would not be administered due to the complexity of the instructions: "Now, I am going to say a group of numbers and letters. After I say

them, I want you to tell me the numbers first, in order, starting with the lowest number. Then tell me the letters in alphabetical order. For example, if I say A-1, you should say 1-A. The number goes first, then the letter. Let's practice. A-2"

I was agreed that the instruction was too long, too verbally complicated and too challenging for the interpreter to translate into ISL. The researcher has administered hundreds of WISC-IV^{U.K} tests and has experienced the difficulties and complexities of these instructions for hearing individuals. It was thought that the complex instructions and the difficulties of translating these instructions into ISL were too difficult to pursue and is not recommended in the administrative manual. The Arithmetic subtest in the Working Memory Index was administered in its place and the correlations between the two subtests used in the WISC-IV^{U.K} was calculated (see above).

5.3.1 Identified Issues with ISL

As the research progressed, it became apparent that using ISL was influencing the performance of the participants in two ways: firstly, some of the questions asked actually provided the participants with either hints or actual answers, secondly, using ISL to ask item questions was hindering the ability of the participants to answer correctly: this was due to the complexity of the language used in the test administration. Examples abound: One question on the Word Reasoning subtest of the Verbal Comprehension Index asks the participant to guess what is being described in this sentence: "This is an animal with a long trunk and big ears". ISL translates this sentence as "This is an elephant".

On the same subtest another sentence is "This has a knob and people can open it and walk through it". ISL translates this as "this+open+door". In the Vocabulary subtest of the Verbal Comprehension Index the participant is asked to give a

definition of a word. Items progress from fairly easy words such as “what is a cow?” to more complex words such as “Ancient” “Absorb” (Video 32, 1.27 seconds) and “Transparent” (Video 32, 1.36 seconds). ISL translations either gave the answer (the sign for absorb is to show something being sucked up with facial expression of sucking) or has to be finger-spelled. This may raise questions about construct validity as the test may be testing a participant’s spelling rather than knowledge of a word. As many D/HOH students have recorded literacy issues, they will either struggle to understand the spelling or the word or be able to read the word supplied on a list.

Items like this abound in the WISC-IV^{U.K} which meant that words has to be finder-spelled or adapted to provide a way of communicating the meaning required. The researcher noted instances of this difficulty as the test was delivered. Difficulties presented in three basic ways: There was no specific sign for a word and that word had to be spelled out, ISL altered the way the question was asked and ISL gave a hint or a clue to the correct answer when it was used to ask a question. Another difficulty was the actual comprehension of the instructions. Some examples are listed on the following page.

5.3.2. Examples of difficulties when using ISL to translate questions from English into Irish Sign Language.

Words that did not exist in ISL or had to be adapted:

The word “Timber” is used in the Similarities subtest: “How is timber like bricks?” Timber was translated as “wood” in most instances. Interestingly, the sign for “wood” is the same for “Trees” which was noted on the “How is Rubber like Paper?” question in the same subtest. The participant responded by stating that “they both

came from wood (trees)". Similarly, there does not seem to be any ISL signs for "Ancient" (signed as "really, really, old" thus giving the answer), "Conflict" (had to be finger-spelled or was signed as "fighting") and "Thief" (signed as "Robber" which can be used in the answer: "someone who robs"). Words such as "Reality" was signed as "Real life then signed as "Reality". Another word that did not have an ISL equivalent was "Fable" which meant that the word was finger-spelled. This was the same difficulty for the words "Non-sense" (video 32, 1.19 seconds), "Winter" "Timber" "Poet" and "Steam".

Words or phrases that were altered:

The word "wallet" was translated as money in the Comprehension subtest: "What are you supposed to do if you find someone's wallet or purse in a shop?" This was translated into ISL as "Boy have money, fall on ground, what you do?"

Similarly the Word Reasoning subtest led to some difficulties around translation: "This is what people do to make things like new again and people do this to things that are broken" was translated into ISL as "If something broke, want new again, what you do?". In the Arithmetic question "Bob has five books. He loses one. How many books does he have left?" was translated as "five books, one gone, how many?" Likewise there was a difficulty with the phrase in Word Reasoning "This makes food taste better", Translated as "what you put in food to make nice?" In the Arithmetic subtest, the question "Three cars park in a car park that already has twelve cars. How many cars are there in the car park altogether?" was translated as "car park, twelve cars side by side, three come in how many now?"

The phrase "this is something most people want, and conflict prevents it" was translated as "Fighting stops it". There seemed to be some confusion with the word

“History” and that of “Heritage”. “History” was translated as “long ago” or “from the past”. Ancient was also translated as “what is like history?”

“How is a Painter like a Poet?” was translated as “Man who paints is like man who writes poems-how?” words were regularly changed to give a simplified meaning:

“This Leads to New discoveries” was translated into “This leads to new findings” and

“Students enrolled in a Karate class” was translated into “Students joined a class”.

This may not seem like a significant change but in terms of the test it is an adaptation and thus may not be reliable in terms of scoring and validity.

Hints or clues given by using ISL:

The phrase “This is part of your head used to smell things” is a good example of ISL giving the answer: Smell is translated by pointing to the nose and making a smelling motion (Video 30, 37 seconds). The translation of “Bricks” in the Similarities subtest question: “How is Timber like Bricks?” “Bricks” as a sign is translated as using a stacking sign with the word “wall” incorporated. It gives the hint by actually showing the translator building a wall. The phrase “This is used to dry yourself after a bath” had the action of drying oneself with a towel (See video 30, 10 seconds). “This is an animal with a long trunk and big ears” actually gives the sign for elephant in the translation into ISL (video 30, 26 seconds). “This is something you were to cover your head” actually has the sign for “Hat” in the translation (Video 30, 57 seconds)

Difficulty with comprehension of instructions:

An example of this challenge for the researcher and his interpreter was the Verbal Comprehension Index subtest of Similarities and the Working Memory Index subtest of Digit-Span Backwards. The word similar was often translated by interpreters as “The same as”. For example, “How is Milk like water?” was translated as “Milk, water

the same, how?" The participant answered "No" or often participants answered by describing the two words independent of each other: "Water before bed and milk in the morning".

The concept of "reverse" or "Backwards" caused a lot of difficulty in the Digit Span Backwards subtest in the Working Memory Index. The instructions state: "Now I am going to say more numbers, but this time when I stop, I want you to say them backwards. If I say 8-2 what would you say"? This caused difficulty as the instructions did not actually give an example. Participants struggled with this instruction.

Hard of Hearing participants difficulties:

Although ISL was used for each participant, some tended to rely on spoken instructions and questions rather than focus on the signing of the Interpreter. As a result of this there were some errors due to difficulty in hearing rather than sign. For example: words were misheard: "Thirteen" was heard instead of "Thirty" while "Thief" was misheard as "Teeth". Finally, "What is Transparent?" was heard as "what is parent?" the participant answered "your mum and dad".

5.3.3 Back Translation

As a result of these findings and through observation of what the interpreters were observed signing, it was decided that some form of back translation needed to be investigated to work out what participants were actually "seeing" when they were asked questions through the interpreter. Discussions were held with the main translator about the possibility of videotaping her signing some of the questions and then showing this video to ISL users for back translation.

This was a difficult negotiation as the interpreter expressed concerns around her sign being judged by other ISL signers. She was concerned that others would state that her sign was wrong or did not have the proper inflections and expressions. This issue will be discussed further in the next chapter. Finally, it was agreed to videotape the interpreter asking some of the questions that were identified as causing difficulty during the testing process. As a way of maintaining the integrity of the test material, it was agreed that some samples would be videoed and only three questions be given to an ISL user to back translate. That way the material would not be open to the public and any given person would only know three questions. Another way of protecting the material was to only use adults as the test was only administered to those aged up to sixteen years eleven months.

The Irish Deaf Society was approached with a view to providing adults to view the video and to offer a translation of what they saw. A copy of this video is provided on a memory stick which accompanies this thesis. References will be made to sequences and time markers for cross-reference. Adults who viewed these videos gave informed consent and signed UEL “Consent to participate” forms. They were shown three clips and were asked to write down what they saw. The questions shown by the researcher are listed below with the answers written by ISL users underneath the question.

1. How is your elbow like your knee? (Video 29, 1.03 seconds)
2. *How Elbow Like Knee?*
3. How is timber like bricks? (Video 29, 1.12 seconds)
4. *How timber like a brick?*
5. How is reality Like Dream? (Video 29, 2.16 seconds)
6. *How real life Dream like reality?*

7. What is Ancient? (Video 32, 44 seconds)
8. *What's ancient?(Really old)*
9. What is a Pest? (Video 32, 50 seconds)
10. *What's the pest?*
11. What is Brave? (Video 32, 50 seconds)
12. *What's Brave?*
13. What do you do if a boy, much smaller than you tries to pick a fight with you?
(Video 34, 1.13 seconds)
14. *If small boy angry what I do?*
15. What are the advantages of taking exercise? (Video 34, 1.25 seconds)
16. *What positive of exercise?*
17. Why should you apologise when you know you have hurt someone's feelings?
(video 34, 1.35)
18. *What say about sorry?*
19. Why would I rather get my news from a newspaper than the T.V? (Video 34,
2.20 seconds).
20. *Why do I prefer to read newspaper or T.V, prefer to read the newspaper.*
21. Now I am going to say a group of numbers and letters. After I say them, I want
you to tell me the numbers first, in order, starting with the lowest number.
Then tell me the letters in alphabetical order. For example if I say A-1 you
should say 1-A. The Number goes first, then the letter (Video 36, 02
seconds).
22. *After I said the numbers and alphabets you do the same as me.*
23. What does Precise mean? (Video 32, 1.48 seconds)
24. *What does precise mean?*

25. What would you do if you came back home today and saw thick black smoke coming out of your neighbour's house? (Video 34, 43 seconds)
26. *If you go back to the neighbour's house and saw thick black smoke coming out of the chimney, what would you do?*
27. Why do we turn off the lights when we leave a room? (Video 34, 1.46)
28. *When leaving the room, why did the light turn off?*
29. Why does the government inspect meat before it is sold to the public? (Video 34, 1.57 seconds).
30. *Why did the government must check the meat before selling?*
31. What are the advantages of having public libraries? (Video 34, 2.10 seconds)
32. *Positive thing-why do we have library?*

As the reader can see, some questions were back-translated with great precision while others actually did not translate the meaning. An example of this would be question thirteen. It was clear that the D/HOH adults had some difficulty with the back translation. The instructions for Letter-Number Sequencing (Question number twenty one) was added to the list to be back-translated as the researcher believed that the instructions were very complex and that the language load was too difficult.

Letter-Number Sequencing from the Working Memory Index was deliberately omitted due to this concern. Arithmetic was substituted for Letter-Number Sequencing as the language load for Arithmetic was judged to be lower. However, the Arithmetic subtest produced some difficulties around the complexity of the language for questions eighteen, nineteen and twenty: question nineteen goes as follows: "Kim is watching eight birds on the ground. Four birds fly away. Two other birds land. How many birds is she watching now? This proved problematic for a number of

participants mainly due to the length of the question and the amount of information that had to be remembered in order to calculate an answer.

5.4 Conclusion

This chapter has reported on three aspects of the research: the statistical results of comparisons of participants' scores on the four aspects of cognitive testing: the Full Scale score of the WISC-IV^{U.K}, the Perceptual Reasoning Index of the WISC-IV^{U.K}, the Two and Four Test scores of the WNV. It also compared the Working Memory scores on the WISC-IV^{U.K} and the WNV as well as investigating the difference between the Two Test and the Four Test scores of the WNV to see whether the Picture Arrangement's language component had any effect on the overall score. Results indicated that there was a significant statistical difference between the results of the WISC-IV^{U.K} and the WNV which may be explained by the use of ISL in administering the WISC-IV^{U.K} cognitive test. There does not appear to be any impact on the use of a (potentially) language-based subtest in the WNV (Picture Arrangement) as there is no statistical difference between the WNV Two-Test and the WNV Four-Test.

The results of the semi-structure interviews held with the participants were presented with some commentary and further analysis will be completed in the following chapter. Finally, the process of using interpreters, the use of ISL and the difficulties and challenges that arose during the research was outlined. The process of back-translation was reported which identified some difficulties resulting in the use of ISL and translators during the cognitive testing of the D/HOH participants. It would suggest that the administration of a cognitive test for D/HOH participants is not simply a matter of using ISL. Indeed, it is much more complicated than that and

results would suggest that administering tests through ISL may even result in lower individual cognitive scores being reported.

The next chapter will now proceed to discuss these results and link the issues identified with present research in the area.

Chapter Six Discussion

6.1 Introduction

This chapter will illustrate how the results obtained in this research are linked to previous research outlined in Chapters Two and Three. A commentary will follow each topic covered and will identify topics which may influence the work of educational psychologists in the British Isles and perhaps further afield. It will also identify any strengths and limitations in the research which will influence future research in the field of intelligence/cognitive testing in the Deaf and Hard of Hearing population. This chapter will follow on the theme of previous chapters by asking questions which have influenced and directed the research.

6.2 Should we test D/HOH individuals with common general intelligence tests?

The main question of this research involved intelligence testing/ cognitive assessment of D/HOH individuals. The National Council for Special Education (NCSE) had issued a policy paper on the Education of Deaf and Hard of Hearing Children in Ireland in 2011 in which it advised that NEPS psychologists “Work towards a psychological service being available with a sufficient level of competency in ISL to administer psychological assessment through ISL” (NCSE, 2011, p65). The aim of this study was to compare cognitive scores of a commonly administered test, the WISC IV^{U.K} with scores obtained from a nonverbal cognitive test, the WNV, administered without any language input from the psychologist. It was shown that tests which include the Verbal Comprehension index of the WISC IV^{U.K} significantly reduce the overall mean I.Q score for this population. In the current study the mean

Full Scale I.Q score for participants was 74.77 which placed participants in the Borderline Mild General Learning Difficulty Range.

The mean scores for the nonverbal WNV test were 91.10 which placed participants in the Average Range for I.Q. The difference in practical terms for these participants is that one result suggests that the children in question presented with general learning difficulties and, as such, would need Individualised Education Plans while the other WNV result would have indicated that the children in the study would have the capability to fully access the Irish educational curricula.

Results from Braden's (1994) seminal meta-analysis fully concur with the present findings. He analysed 324 independent studies which reported on the intelligence scores of D/HOH populations and reported that tests that included verbal intelligence scores consistently underreported I.Q scores in this population. Earlier studies by Vernon (1967) also cited average I.Q scores for the D/HOH populations in the Borderline Mild General Learning Difficulty range. Braden (1994) and Sullivan (1982) have identified higher Performance I.Q scores (PIQ) in the D/HOH population when compared to their Hearing peers. Krouse and Braden (2011) have suggested that PIQ includes Processing and Visual Discrimination Skills which D/HOH populations tend to excel (See also Raven, Raven and Court, 1998a, 2000).

Once the performance aspect of the PIQ was removed and split into distinct indices of Processing Speed and Perceptual Reasoning (Fluid Intelligence) scores tended to be lower in this population (Krouse and Braden, 2011). Perceptual Reasoning Scores averaging out at 93.21 (Krouse and Braden, *ibid*) were reported for the WISC-IV^{U.K} version with a sample of 128 participants although 10 different psychologists were involved in the testing. This mean score is quite similar to the

results of the present research finding of a Perceptual Reasoning mean score of 86.6 and would indicate that D/HOH participants are producing lower scores than the standardised mean for the WISC IV (American version) and the WISC IV^{U.K.} of 100.

The answer to the question posed at the start of this section is clear: We should not cite Full Scale I.Q scores for D/HOH individuals when the score includes language-based tests and are administered through sign language unless the difficulties associated with this process are clearly identified and outlined. This directly contradicts the NCSE policy paper. The WISC-IV^{UK} Perceptual Reasoning Index scores in the present research produced standard scores in the Low Average range which significantly underrepresents the **g** of D/HOH participants. Therefore, to answer the question posed at the beginning of this section, the answer would seem to be: “We can test the intelligence of D/HOH populations but we should not use tests which involve Verbal Comprehension or tests that have heavy language loading in terms of their administration. It is best to use nonverbal tests that have little or no language input but we should be aware that D/HOH individuals may produce lower than the standard mean of 100 due to late diagnosis of their hearing difficulties, their language, environmental and educational delays

6.2.1 Why are D/HOH populations scoring lower mean Perceptual Reasoning and Nonverbal I.Q scores?

This question is quite sensitive and must be answered with evidence-based results. The current study indicated that the use of interpreters to help administer the WISC IV^{U.K.} may have hampered the participants rather than helped them. The reason for this is twofold: The issue of back-translation was identified as a problem for ISL users (see section 5.3 and following sections for a full description of difficulties

surrounding the use of ISL translators) as was the issue around comprehension in the D/HOH population. Marschark, Leigh, Shapere, Burnham, Convertino, Stinson, Knoors, Vervloed and Noble (2006) have illustrated the issue of comprehension in the D/HOH population. By testing various methods of lecture supports including sign language translators, C Print and CART, Marschark et al (ibid) and Marschark, Convertino, Macias, Monikowski, Sapere and Seewagen (2007) have shown comprehension of lecture content at less than 50%. This might have been a factor in the administration of the WISC-IV^{U.K} through an interpreter. The instructions for the administration of the WISC-IV^{U.K} can be quite complex and language-laden. The Perceptual Reasoning Index score is often used by educational psychologists as a measure of Fluid Reasoning but the subtests involved have heavy language loading in terms of instructions which may explain the lower scores than the WNV which has no language input.

However, a similar question must be posed in relation to the nonverbal intelligence test used (the WNV). This test has no language input and uses gestures and visual prompts. The test was not administered through ISL and therefore issues around comprehension and interference can be excluded. The speculative answer to this question might include delayed Theory of Mind (ToM) development, delayed language acquisition and the issue of late diagnosis of hearing impairment. The environmental conditions for the D/HOH participants were not optimal: most had late diagnosis and have Hearing parents: two key issues which have been addressed in Chapter Three.

Peterson, Willman and Liu (2005) have identified late ToM development in D/HOH populations (See also Perner, 1991, Courtin, 2006 and Melot and Courtin, 2000). The delay in ToM development among D/HOH populations was traditionally

interpreted as delayed cognitive development (Courtin, 2000) whereas it is now understood to be a function of delayed language acquisition (Moeller and Schlick, 2006). Deaf children of Hearing parents can often experience late diagnosis and as a result have missed key developmental milestones associated with cognitive development (Siegal, 1995, and Peterson and Siegal, 1998). Russell, Hosie, Gray, Scott, Hunter, Banks and Macaulay, 1988) argued that D/HOH children often lag ten years behind their Hearing peers. It is now understood that delayed language acquisition can impair comprehension and cognitive understanding on ToM tasks. Marschark and Everhart (1999) have identified the delay in “constraint” or category-based questioning in D/HOH children playing the “Twenty Questions Game”. Mayberry (2002, p71) states; “Children who are born Deaf clearly miss a great deal”. While one might concur with Marschark (2003, p464) who states: “There is no evidence that hearing loss diminishes cognitive abilities in general” there is clear evidence that the environmental, social and emotional effects of being born Deaf or Hard of Hearing impacts on language acquisition, language comprehension and understanding which may go some way in explaining the lower than average mean Full Scale I.Q’s and perceptual Reasoning I.Q scores in this research. To sum up this section Meadow’s (1968, p28) commentary is apt: “The basic impoverishment of Deafness is not lack of hearing but lack of language”. All evidence indicates that this is not an issue for second-generation D/HOH individuals as they have access to language from birth and grow up in a language-enriched environment (Lederberg and Spencer, 2001).

6.3 If we use intelligence tests through sign language interpreters are we “Levelling the playing field?”

This question has been the most puzzling for many ISL supporters and users. The Deaf organisations that supported the research have previously indicated that they would support the use of sign language interpreters for intelligence testing (CIDP, 2011) and in meetings with these organisations it was made clear to the researcher that this was a policy that would be pursued through proposals to the NCSE and the Irish Government. The history of Irish Sign Language and sign languages in general is one of exclusion and lack of official recognition. The Irish government does not recognise ISL as an official language and hence access to interpreters is not a *right* for D/HOH citizens whereas Irish citizens have the right to be tried in a court of law in the Irish language, have translated documents made available in Irish and can even demand that all government services be delivered through the Irish language. A D/HOH person, on the other hand, does not have, for example, the right to a sign language interpreter when they meet an educational psychologist from NEPS, a state organisation. . Psychologists can request an interpreter but it is by no means a right or a guarantee that an interpreter will be sanctioned. D/HOH individuals face the same circumstances when they attend hospitals, social services, schools and work placements. It makes sense then for members of the D/HOH community to promote their language when they get an opportunity hence the inclusion of the part on the use of Irish Sign Language when the NCSE sought submissions from the public.

Using a sign language interpreter simply does *not* “Level the playing field” as Jacobs (1977) suggested. Results clearly show that using an interpreter creates the optics of meeting fairness criteria for D/HOH examinees: we are using their language and we

are testing their ability through their preferred mode of communication. The reality is that ISL cannot be judged as a fair substitute for D/HOH sign language users as essentially one is testing a second language (L2) and scoring it on answers compared to first language (L1) norms and standardisation. Throughout the testing process translators struggled to convey the questions to the D/HOH participants in a way that accurately translated the question or in a way that did not give the answer away (See Chapter Five, 5.3). Examples of issues with the use of the back-translation of the interpreters show clearly that the questions on the Verbal Comprehension Index subtests were not translatable or were misread by adult ISL users.

The most important result of this research is the mean scores of the D/HOH participants in the Borderline Mild General Learning range when using an ISL interpreter. It could be argued that this is the optimal best-practice outcome for the D/HOH community in that there is the use of ISL through a professional interpreter but the real Full Scale I.Q outcomes clearly under-represent the true ability of D/HOH individuals. The NEPS draft guidelines advise against the use of Verbal Comprehension tests for this very reason and also indicate potential difficulties with the assessment of an L2 when using an L1 test.

6.4 Do D/HOH individuals display advantages in Visual Working Memory?

One of the issues identified in the administration of the WISC-IV^{U.K} involved the inclusion of the Working Memory Index (WMI). If the Full Scale I.Q of the WISC-IV^{U.K} was to be administered through ISL, then Working Memory had to be included. The main problem associated with this was that of the two subtests used, Digit-Span was essentially an *auditory* working memory test: Numbers are called out and the

examinee has to memorise the numbers and call them back to the examiner. In order to test the efficacy of using ISL to administer the WMI, Digit-Span was administered through ISL as was the Arithmetic subtest. Comparisons were made with the Working Memory test on the WNV: Spatial Span, also known as Corsi Blocks which is meant to be a visual-perceptual test of Working Memory. The results indicate that the WNV Working Memory test produced higher mean scores (94.5 Standard score compared to 76.6 on both WMI subtests in the WISC-IV^{U.K}) while no obvious skill set was indicated on the WNV, it is clear that tests of Working Memory involving ISL produce lower scores thus disadvantaging D/HOH participants.

Clear links to previous research abound: Marschark, Convertino, Macias, Monikowski, Sapere and Seewagen (2007) and Lichtenstein (1998) have illustrated that signing takes up more “space” in Working Memory tasks thus reducing capacity for D/HOH sign users. Mayberry and Waters (1991) also noted the effect of sign language usage on finger spelling. As noted in Chapter Five, many signs used for the Verbal Comprehension subtests (Vocabulary, Comprehension, Similarities and Word Reasoning) involved the use of finger spelling (Section 5.3.2). This would have reduced Working Memory capacity thus introducing a confounding variable. The Corsi Blocks, however, were Working Memory tests that involved visual processing: the examiner touched certain blocks on a form board and the examinee has to repeat the sequence produced. Research has shown that sign language users have developed particular visual-spatial skills through using perspective taking and the visual tracking of hand signals as well as scanning for facial signing (Wilson, Bettger, Nicolae and Kilma, 1997). One of the key tactics used by Hearing participants in tests of auditory Working Memory is the use of rehearsal. We all can identify with the rehearsal of a telephone number while we struggle to find a pen. Hearing people use

rehearsal to help them in tasks of auditory Working Memory whereas D/HOH do not (Bebko and McKinnon, 1990) if you cannot “hear” the numbers to be remembered there is no point in rehearsing them. The use of sign language does not support the use of rehearsal (Hall and Bavelier, 2010). The results of this research indicate a preference for Working Memory tasks which utilise visual-perceptual skills. This was also identified a total of nineteen participants indicated a preference for visual-perceptual tests such as Block Design or the Corsi Blocks. (See Chapter Five section 5.2.3). Obviously, D/HOH individuals live in the visual world and use their vision and visual perceptions to communicate through sign language. It is therefore not surprising to see a strong performance in tests of visual-perceptual skills although there were no higher than average scores produced. This again may be due to the fact that the vast majority of the participants were Deaf children of Hearing parents and thus did not possess the skills and visual acuity of second generation Deaf individuals (Bettger, Emmory and Bellugi, 1997). The results of the research would indicate that the inclusion of Working Memory subtests to calculate a Full Scale I.Q of D/HOH individuals would significantly under-represent the individuals’ ability and thus lead to lower FSIQ mean scores.

6.5 Participants’ views of intelligence testing.

One of the more interesting aspects of the present research was the interviews held with the D/HOH participants eliciting their views of the process. Educational psychologists (E.P’s) have a lot of “power” in the assessment process, especially E.Ps from NEPS. Schools have a very limited amount of contact time with NEPS E.Ps and, as a result, children are often “prioritised” on a list of students to be referred. Parents are often relieved to be meeting an E.P that may be able to help their child and thus power differentials often exist in this situation. It has been

previously illustrated how D/HOH individuals have been assessed in the early years and once a diagnosis is developed this can trigger supports from the NCSE such as extra support teaching hours, an SNA and access to the Visiting Teacher Service. As resource hours are a commodity in short demand and with E.P time very limited, D/HOH children are rarely prioritised for review assessments. There is no official sharing of information between the Visiting Teacher Service and NEPS and therefore D/HOH children in mainstream schooling may never be referred to a NEPS E.P.

The process of offering intelligence/cognitive assessment for D/HOH students was regarded as a valuable opportunity for parents, schools and students alike. The researcher wanted to reduce aspects of the aforementioned power differential by ensuring that informed consent be properly offered and for the assessment results to be the property of the parents of the D/HOH participants. Although this resulted in some complaints from schools who participated in the research it was key to the emancipatory aspect of the research (Robson, 2011). The power shift was in favour of the individual parents/guardians and D/HOH participants themselves in that parents/guardians could decide not to share the information in the generated reports and the participants themselves had an option not to participate or to withdraw their participation at any stage. The fact that all the parents/guardians opted to share the information with the school was an indication that they felt the reports would benefit the child in question. Also, one of the children in the research opted not to participate not once but twice which illustrates the fact that informed consent was practiced. In this instance, the child's parent wanted the assessment to take place but the child did not.

Chapter Five includes sections in which the D/HOH participants were asked about their experience of completing the tests and their views on what intelligence means

to them (Section 5.2). The majority of the participants (66%) preferred the nonverbal test, the WNV. Over 80% of the participants equated academic and school-based experience with “Intelligence” when asked (5.2.5 and 5.2.6). It is clear that the D/HOH participants gave examples that are quite commonly accepted with the concept of intelligence explored in Chapter One in that intelligence tests are designed and organised to predict academic outcomes (Flanagan and Kaufman, 2004, p238). While some participants associated “Intelligence” with emotional or social skills (5.2.7), these examples were few and could also be linked with school-based outcomes such as “I help others in school when I finish my work” (5.2.6, P6). What is clear from the interviews held with the D/HOH participants is that they commonly accepted that the tests did indeed test their “Intelligence” and that this measurement was connected with how well they did in school. Calvin, Fernandes, Smith, Visscher & Deary (2010) have reported very high correlation (0.83) between intelligence tests and academic outcomes at Key Stage two performance in the U.K. However D/HOH individuals have historically low attainment scores (Marschark, 2010, Leeson, 2012) and it is important to distinguish between academic outcomes and ability or intelligence.

6.6 Strengths and Limitations of the Present Research.

6.6.1 Strengths

This is the first time that an Irish sample of D/HOH participants have been involved in studies that have implications for Irish educational psychologists and the D/HOH community in general. The sample size ($n=31$) is more than adequate when one compares the D/HOH sampling of the WNV (Flanagan and Kaufman, 2004). In terms of the Irish school-going population, the sampling was roughly 16.5% of the D/HOH

special school population which gives a robust sampling of the D/HOH students in an Irish educational setting. There are no reported sample sizes in the WISC-IV^{U.K} Technical and Interpretive Manual whereas the Wechsler Nonverbal Scale of Ability reports a sample size for D/HOH participants of 87 (Wechsler and Naglieri, 2006, p11). When compared to the sample size of the WNV for an American school population, the current sample of 31 could be considered a strength in methodological terms.

Another strength of the present research is the fact that the testing of the D/HOH participants was undertaken by one researcher compared to other methodologies used in similar research (Krouse and Braden, 2011 and Krouse, 2008). In previous research, psychologists were asked to share data and data analysis was undertaken by individuals who had not met with the D/HOH participants. Both Krouse and Krouse and Braden (Ibid) have reported as a weakness of their research that errors could easily have been made as they relied on third parties to administer the intelligence test as well as record the data.

The issue of obtaining informed consent was sidestepped by both Krouse (2011) and Krouse and Braden (2011) as this was assumed to be completed. This research wanted to empower and respect the D/HOH participants for several reasons: in ethical terms the researcher was working with a culturally disadvantaged group, with acknowledged issues around power differentials and also the research involved work with young children which is always a sensitive area. One of the strengths of this research was the inclusion of the “Voice of the Child” in the results. It is the difference between testing “on” children as opposed to testing “with” children. Parents were given the right not to share the results with schools which only one

parent chose to do initially. The participants were given the choice not to participate and withdraw at any time which did occur in one instance.

One other strength was the pragmatic approach of the research: the researcher is a practising E.P working in NEPS and the research was influenced by real-life experiences on the ground and the response to government policy advice. It provides practising E.P's with evidence of best practise and may be instrumental in changing government policy. At the time of writing meetings have been scheduled between NEPS and NCSE management with a view to sharing the results. The Deaf organisations who supported the research have already changed their submissions to the Irish government in relation to the on-going D/HOH education debate.

6.6.2 Weakness in the present research.

As with all research that deals with D/HOH populations, the wish would be that there were more participants: while the sample size was adequate it would have been better to have three or four distinct groupings: Second generation D/HOH participants, a Hearing control group, a group with cochlear implantation and the group used: D/HOH individuals with late diagnosis. The D/HOH population is, by definition, a heterogeneous group: some children are born deaf, some become deaf, some have genetic conditions that cause hearing impairment while others experience deafness as part of a co-morbid condition (with autism for example). The research would be more robust if the four groupings mentioned could have been included. However, finding homogenous D/HOH groups in sufficient numbers has been an ongoing challenge for researchers in this field (Tukey, 2002).

One issue with the present research is the fact that the two I.Q tests were administered on the same day due to the constraints of time and the availability of the interpreters. The fact that at least half the participants travelled to the Deaf Education Centre in Cabra, Dublin or to the offices of DeafHear.ie to meet with the researchers meant that the two tests had to be administered on the same visit to facilitate the process. The participants who travelled were on their summer holidays and it was reasonable to assume that there would be some circumstances in which a second visit might not have been made. Participants were given a half hour break between the tests and refreshments were made available for parents/guardians, the children who participated and the interpreters who also needed a break from translating. Ideally, the two tests would have been administered with a three month break to eliminate any elements of test familiarity. There was only one subtest that was administered twice: Matrix Reasoning which is in both tests. Statistical analysis in section 5.1.6 indicates that there was no evidence of a practice element between the two tests.

The use of interpreters was another factor that was not ideal: The main interpreter was not available to work outside of Dublin by her employers and, as a result, a small number of interpreters were also used outside of the Dublin area. While this affects the consistency of the sign language used, it is important to note that the D/HOH participants were asked to indicate whether they had a preferred interpreter/communicator in deference to Deaf culture. This essentially ensured that the use of the same interpreter was not in any way predetermined from the outset. In the Limerick school, for instance, several of the participants indicated that they wanted their SNA to interpret for them despite the fact that a professional interpreter has been employed for the day. An interesting aspect of this situation was the

development of the back-translation concept which was developed as a direct result of the use of different interpreters. This is an example of the pragmatic approach utilised which underpinned the approach to research in the real world.

Ideally the research would have included the use of academic attainment tests for several reasons: Intelligence tests are essentially a predictor of academic outcomes and it would have been of value to calculate the link between Verbal Comprehension scores and reading ability, spelling and reading comprehension. Unfortunately this is a whole piece of research in itself but one worth investigating given the long history of underperformance in the academic world of D/HOH students.

6.7 Implications for the Practice of Educational Psychologists in the Irish Context

The challenges of using intelligence testing in the D/HOH population in Ireland are actually well-known in the NEPS service. At present, there is a set of draft guidelines on the assessment of D/HOH students which is available to all NEPS psychologists. The publishing of the “Education of Deaf and Hard of Hearing Children in Ireland” by the NCSE has an explicit reference to the use of ISL by NEPS psychologists when cognitively assessing D/HOH children. NEPS were consulted in the development of this policy document but recommendations from the NEPS draft guidelines do not seem to have been included except for a reference to the use of nonverbal test material (NCSE, 2011, p31). It would seem that the NCSE policy document might need to be updated in the light of the results from this research. In summary, educational psychologists working in the Irish context specifically should:

- Develop an awareness of Deaf culture and understand the relevance of the desire for D/HOH sign users to have their language respected when E.P's work in this community.
- To not use tests that include language components, especially Verbal Comprehension subtests when working with D/HOH individuals and to be aware that using such tests will underestimate the general ability or **g** of the examinees.
- The use of nonverbal tests will yield different results for different D/HOH participants: for example, second generation D/HOH will score closer to the mean standardised score of 100 while D/HOH children of Hearing parents are more likely to score significantly lower standard scores even if they are in the Average range of cognitive ability
- The common practice of using the Perceptual Reasoning Index score as a measure of fluid (or nonverbal) intelligence is unreliable due to the fact that Perceptual Reasoning Index subtest instructions can have a heavy language loading thus influencing the ability of D/HOH's examinees ability to comprehend the instructions.
- Using sign language does not "level the playing field" as intelligence tests use L1 language rather than the L2 (sign language) of D/HOH examinees. This research identified several difficulties around the use of translators including the difficulties of CALP vs. BIC and the range of Irish Sign Language's lexicon.

6.7.1 Transferability of Recommendations for E.P Profession.

Given that the Wechsler series of tests are commonly used in the Western world, many of the recommendations listed in section 6.7.1. can be transferred for international E.P practice. Each country has its own sign language and many of the same challenges have been identified when using sign language in general: the difficulty with comprehension, fingerspelling and the range of the lexicon of the sign language itself. As Meadow stated as far back as 1968, “the basic impoverishment of deafness is not lack of hearing but lack of language” (Meadow, 1968, p28). The use of sign language in the process of testing intelligence does not give an advantage or make things more equitable for D/HOH individuals as it involves the use of an L2 to test knowledge of an L1.

Therefore, best practice when using intelligence tests with the D/HOH population is for the E.P to be fully aware of the challenges that arise when using specific tests. For example, the WISC-IV^{U.K} may be a good way of assessing the language acquisition of D/HOH individuals and may also help assess sign language development. Cognitive tests that measure **g** in a nonverbal way may be a good starting point for any assessment of D/HOH individuals.

The assessment of achievement in the D/HOH school-going population would also be wise given the high correlation between attainment and intelligence tests. However the E.P profession would need to be aware of the historic underachievement of this population. The impact on delayed language acquisition on the D/HOH population needs to be understood in the light of how the E.P profession test attainment and Verbal Comprehension. The sample report in Appendix G notes ability scores in four areas (Full Scale I.Q of the WISC

IV^{U.K.}, the PRI of the WISC IV^{U.K.} and the Two and Four test results of the WNV. The feedback obtained from this format was very positive from the parents and school staff. The E.P profession should be aware of the difficulties that can develop from the use of sign language interpreters. Results from this research indicates that D/HOH individuals did not fully comprehend or were mistaken in understanding what was signed to them. This may have underestimated the ability of the participants and may explain the lower mean reported scores on the WNV.

6.8. Future Areas for Study

An ideal study would use four distinct groupings of D/HOH participants: Second generation D/HOH, D/HOH of Hearing Parents with no additional disabilities, Cochlear Implanted D/HOH children and a control group of Hearing children with no additional disabilities. Intelligence tests would be administered through sign language with an interval of several months to control for the practice element and a supplemental back-translation would be carried out to test for comprehension. Academic outcomes would also be tested for as well as having qualitative input from the D/HOH participants. The data obtained from this research will be available to other researchers in an effort to add to the body of knowledge obtained on the WISC-IV^{U.K.} and the WNV. A clear need for a standardised sign language test for D/HOH children was identified during the course of this research. A present, there is no standardised test for assessing the sign language ability of D/HOH children and as a result, speech and language therapists, teachers for the Deaf and the E.P profession may be over/underestimating the language ability of D/HOH children.

The use of standardised attainment tests on D/HOH children may also present with difficulties around administration and interpretation. An example of this would be the use of spelling tests and the signing of words that are finger spelled rather than signed.

6.9 Conclusion.

The research for this thesis developed as a result of a practical question which was influenced by Irish Government policy: “Should Educational Psychologists use Irish Sign Language when testing the intelligence of D/HOH children?” A pragmatic approach was adopted as the researcher is a practising E.P who works with D/HOH children “on the ground”. The use of an emancipatory pragmatic framework was developed to “Help change or make improvements (and) to influence policy or practice” (Robson, 2011, p38). In order to be inclusive and respectful of the Irish Deaf community the researcher adopted a mixed method approach of gathering empirical data in the form of test scores as well as eliciting feedback from the D/HOH participants around their experience of the testing procedure and materials.

Statistical results indicated that the use of Irish Sign Language (ISL) in intelligence testing of D/HOH participants produced the lowest Full Scale I.Q scores out of four different measures. It is clear that this would not be best practice for E.P’s in general as educational interventions could be erroneous on the supposed weak intellect reported in the mean FSIQ obtained in this research. The common approach of using the Perceptual Reasoning Index of the WISC-IV^{U.K} was also shown to produce scores that under-represented D/HOH’s participants intelligence or **g**. The use of a nonverbal intelligence test produced

scores in the lower end of the Average Range of I.Q in D/HOH participants. The results indicated a significant statistical negative effect for the use of ISL for the D/HOH participants. The reasoning behind the lower reported I.Q scores on all tests (including the WNV) have sound underpinning in the literature. D/HOH children who are born to Hearing parents have traditionally been diagnosed late with a hearing loss. This delay has a profound impact on the cognitive development of these children. The resulting delayed acquisition of language, the impoverishment of vocabulary and sign language usage (in the main) of their parents and their access to quality education results in certain developmental milestones being delayed or not fully developed. An example of this would be the reported delayed Theory of Mind (ToM) of D/HOH children. The use of sign language in the testing of intelligence in the D/HOH population may also be an element of the lower overall mean scores in the D/HOH population. The difficulties that were highlighted in the use of back-translation in this research identify potential problems around the actual comprehension of the test questions.

Testing the intelligence of D/HOH individuals must be culturally sensitive but also informed by good practice: while it seems to make sense to test D/HOH children in their first (L1) language, this research, along with previous research in the field has shown that to do so significantly under-represent the intellectual ability of D/HOH individuals. The practice of E.P's in the Irish context can now be informed in line with the evidence of international research. As a result of this unique Irish research, Deaf organisations have adopted these results and have changed their policy recommendations to the Irish Government. The educational psychology service in which the researcher works has begun a process of sharing the

research with the National Council for Special Education (NCSE) with a view to amending their 2011 policy recommendations on the assessment of Irish D/HOH children.

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Appendix A. The WISC-IV^{U.K.} information on subtests.

The WISC-IV^{U.K.} is comprised of fifteen subtests: Block Design, Similarities, Digit Span, Picture Concepts, Coding, Vocabulary, Letter-Number Sequencing, Matrix reasoning, Comprehension, Symbol Search, Picture Completion, Cancellation, Information, Arithmetic and Word Reasoning. These subtests are grouped together to form four indices: Verbal Comprehension Index, Perceptual Reasoning Index, Working Memory Index and Processing Speed Index. The four indices are used to calculate a Full Scale Intelligence Quotient or FSIQ.

Verbal Comprehension Index (VCI) linked to the concept of Crystallised Intelligence (**Gc**)

Similarities: the examinee is presented with two words that represent common objects and are asked to describe how they are similar or “Alike” to each other. (Gc crystallised intelligence)
Vocabulary: the examinee is asked to give a definition of a displayed picture or word that is read aloud and is shown to the examinee. (Gc crystallised intelligence)
Comprehension: the examinee is asked to give answers to questions that are posed by the examiner. The questions cover social understanding and general principles underlying social interaction (Gc crystallised intelligence)
Information: the examinee is asked to answer general knowledge questions (Gc crystallised intelligence)

Word Reasoning: The examinee is asked to identify a common concept after hearing a series of clues. (Gc crystallised intelligence and Gf induction)
Information and Word Reasoning are supplemental tests which can be administered to either get a fuller understanding of the examinee's abilities in this ability or to replace a subtest that was interrupted or administered incorrectly.

Perceptual Reasoning Index (PRI) linked to the concept of Fluid Intelligence (Gf)

Block Design: the examinee is shown a picture or a model of a shape and is asked to copy the shape using red and white blocks within a specific time limit. Some items have a time bonus. Gv spatial relations
Picture Concepts: The examinee is presented with two or three rows of pictures and is asked to pick one picture from each row which represents a group with a common characteristic. Gf Fluid reasoning
Matrix Reasoning: the examinee is asked to complete a matrix choosing from a set of five suggested answers. Gf Fluid reasoning
Picture Completion: The examinee is shown a series of pictures that have something missing within a specific time limit. Gc General information and Gc.
Picture Completion is a supplemental test which can be used as a substitute score.

Working Memory Index (WMI) Linked to the concept of short-term working memory (Gsm)

Digit-Span: the examinee is asked to repeat a series of numbers called out aloud in order in two formats: Digit-Span forwards (repeating the numbers spoken by the examiner) and Digit-Span backwards (repeating the numbers called out by the examiner in reverse order). Both scores combine to calculate the Digit-Span score. Gsm Short term working memory
Letter-Number Sequencing: The examinee hears the examiner call out a sequence of letters and numbers and is asked to call the back to the examiner in numerical and alphabetical order. Gsm Short term working memory
Arithmetic: the examinee is asked to mentally solve a series of arithmetic problems within a specific time limit. Gsm Short term working memory and Gf quantitative reasoning
Arithmetic is a supplemental subtest which can be used to substitute for either Digit-Span or Letter-Number Sequencing.

Processing Speed Index (PSI) linked to the concept of hand-eye co-ordination speed (Gs)

Coding: the examinee is asked to copy a set a symbols from a key grid of paired symbols. Using the key, the examinee fills in the missing symbol of the pair shown on the key grid. This subtest has specific time limit. Gs processing speed

Symbol Search: the examinee is asked to confirm whether a target symbol is present in a group of symbols within a specific time limit. Gs processing speed
Cancellation: The examinee is asked to cross out (with a pencil) target pictures within a random and structured arrangement of pictures. Gs processing speed
Cancellation is a supplemental test which can be used to substitute for Coding or Symbol Search.

The combination of the four indices are used to calculate a Full Scale I.Q (FSIQ). Each subtest produces a raw score which is converted to scaled scores from 1-19, and are then summed to create a sum of scaled scores for each index. The ten subtests are summed to create a Full Scale summed score. The summed scales are then converted into Composite scores for the four indices and the FSIQ. Composite scores of 90-110 are described as being in the Average Range of cognitive ability. In certain circumstances, if there is a gap of 23 Composite points between the lowest composite score and the highest composite score, a General Ability Index score is calculated using the PRI and the VCI (providing the gap between these scores is not >23 points) Flanagan and Kaufman, p 132, 2004).

The Wechsler Nonverbal Scale of Ability (WNV), 2006, information on subtests.

The WNV is a cognitive test that produces a FSIQ and is comparable with the construct of g used in the Wechsler series. Rather than being a test of “Nonverbal” ability (in comparison with the PRI of the WISC-IVU.K), it is a cognitive test that is administered nonverbally. There are some gestures used but

essentially all subtests have a visual prompt and explanation shown to examinees before each subtest begins (Wechsler and Naglieri, p3, 2006). For a full description of nonverbal testing see Appendix D.

The WNV is a series of tests administered individually to examinees. There are six subtests within the WNV: Matrices, Coding, Object Assembly, Recognition, Spatial Span and Picture Arrangement. As “not all subtests were appropriate for all ages” (Ibid, p3) the WNV is divided into two age ranges: 4:0-7:11 yrs. and 8:0-21:11 yrs.

Within the 4:0-7:11 yrs. Range, the Matrices, Coding, Object Assembly and Recognition subtests are used, while within the 8:0-21:11 yrs. Range, Matrices, Coding, Spatial Span and Picture Arrangement are used. The subtests that differ from the WISC-IVU.K are described below:

Object Assembly: The examinee is given pieces of a jigsaw and is asked to complete the picture without any visual prompts or template to work from. This subtest has a timed cut-off. Gf Fluid reasoning
Recognition: The examinee is shown a stimulus symbol for three seconds and is then asked to identify the shown symbol from a series of similar symbols. Gsm short term working memory
Spatial Span: This subtest uses the Corsi Blocks and the examinee is asked to replicate a series of “taps” on the blocks in both identical sequence and in reverse order. Gsm short term working memory

Picture Arrangement: the examinee is shown a series of picture cards and is asked to arrange them in an order that makes sense or tells a story that makes sense. This subtest has a timed cut-off. Gv Visual processing

Composite Scores of:	
Very Superior	130 and Above
Superior	120-129
High Average	110-119
Average	90-109
Low Average	80-89
Borderline	70-79
Extremely Low	69 and below

The WNV can be administered in two forms: the Two test or the Four test format. The Two test format for ages 4:0-7:11 is Matrices and Recognition while the Four test has matrices, Coding, Object Assembly and Recognition. For ages 8:0-21:11 the Two test format uses Matrices and Spatial Span while the Four test uses Matrices, Coding, Spatial Span and picture Arrangement. Each subtest produces a raw score which needs to be converted into a T score. T scores are then used to calculate a Full Scale ability score. As with the WISC-IVU.K, the same Full Scale

Appendix B. A Brief History of Intelligence Testing.

In this section the author will outline a brief history of how psychologists have addressed the issue of defining and measuring intelligence. Further information will be giving regarding alternate hypothesis of what Intelligence is and how it can be measured.

As far back as two thousand years B.C Chinese society had a sophisticated civil service which administered the vast geographical area that was ruled by the emperor. In order to enter this service one had to sit an aptitude test which measured the candidate's ability. This way of measuring a candidate's ability was unique in the way that all candidates were administered a standard objective test and their score or performance on the test determined their eligibility (Marr, 2012)

Most of the Western World operated on a system which spurned meritocracy right up to the last century in that the ruling elite usually nominated family members (Nepotism) or through a highly stratified society whereby a small elite ruled the vast majority of indentured peasants (Marr, *ibid*). With the advancement of democracy and civil rights, equality of opportunity became more normalised and ways of categorising people by ability rather than their birth heritage or family influence became necessary.

Sir Francis Galton, known as the father of intelligence testing (Kaufman, 2006), was the first to theorise on intelligence and test his ideas on individuals. Galton essentially brought science into the measurement of intelligence by testing individuals' abilities in areas such as sensory and motor tasks. He posited that more intelligent people should have well developed senses and hence would be quicker and more accurate in tests of speed and perception than less intelligent

individuals. His contributions to the field were limited in validity but ultimately influenced the idea that intelligence could be measured and that people could be categorised into ability classifications.

The first instance of the use of psychological testing came about as a result of efforts of the French government to ensure that all children attend appropriate school placements. In an effort to support children who were not able to access education, Alfred Binet and Theodore Simon were tasked with the identification of weaker children who may need more specialised help (Fancher & Rutherford, 2012)

Binet and Simon developed a whole series of tests in 1905 which measured memory, judgement, comprehension and reasoning. These became known as the Binet-Simon Scales. The Binet-Simon scales were language based in that they required either written or oral responses (Kaufmann, 2000). This is the first government-led categorisation of a student populace by means of intelligence testing and while this is quite a commonplace activity and concept today, the idea that testing would take place to identify needs of children was quite revolutionary.

The Binet-Simon tests developed over a number of years and increased the age band of tested children from three to fifteen years (with some adult tests also).

These tests became widely known and a number of individuals and government organisations became interested in translating and adapting the Binet-Simon Scales. While psychologists and scientists such as Goddard, Kuhlman, Terman and Yerkes adapted and worked on developing the Binet-Simon scales (Kaufman 2004), the most influential breakthrough in intelligence testing developed when Lewis Terman (1916) translated and adapted the Binet-Simon scales for use in

the U.S military. What is interesting about the Terman translation and adaptation is the fact that he changed culturally significant references and phrases in the test and changed the translation from word-for-word to more readable and culturally appropriate phraseology. The concept that intelligence tests could be culturally biased was unknown at the time and today is a significant measure of a valid test of intelligence.

An example from the WISC IV (the most commonly used test in the Western World, Kaufmann 2004) is a question “what are the four seasons of the year?” This can be seen as a culturally biased question in that many children come from a climate where there are only two seasons: wet and dry. Another such question is “How many is there in a dozen?” This may be seen as an outdated or invalid question as many modern children are not exposed to that term and eggs are often sold in different amounts other than half-dozen and dozen.

Terman’s Stanford-Binet and its subsequent revisions have become a highly popular test and has been one of the most commonly administered tests in the U.S for more than forty years (Kaufman, 2004). Arthur Otis, a student of Terman, developed a group administered test for the U.S army to assess recruits for the First World War. These tests were essentially pragmatically driven as the U.S army wanted to categorise their recruits and to identify potential officers and individuals who may not have been able to cope with basic training (Anastasi and Urbina, 1997). An initial language-based test was developed and was called the Army Alpha (Kaufman, 2004) which was followed up with the Army Beta-a test especially developed for non-English speaking recruits such as recent immigrants from Europe.

This, in terms of the history of Intelligence testing, was a significant development in that this is the first group administered test that took cognisance of the fact that knowledge of language (or lack of) could influence a performance on an intelligence test. The concept of non-language (commonly called non-verbal) testing was established and has been an important aspect of intelligence testing since.

A further development occurred when the U.S army had to develop a test for individuals who were suspected of “malingering” (Kaufman, 2004). The development of mass testing and the idea that individuals could be categorised by their measured intelligence was widely accepted in U.S government circles. After the war, testing of immigrants became commonplace (Kamin, 1995) and the notion of ethnic stereotypes (Herrnstein and Murray 1996, p343) led to the development of laws governing immigration (Immigration act of 1924 issuing quotas on the basis of nationality).

David Wechsler; the development of standardised intelligence testing.

David Wechsler was the first psychologist to use statistical information to develop norms for age populations and to link test material to the general intelligence score. He developed the concept utilised in the Army Alpha and Beta tests to test individuals in terms of Verbal and Performance abilities. This introduces the concept of verbal and non-verbal intelligence skills being of equal value and significance. Wechsler defined intelligence as an individual's ability to adapt and constructively solve problems in the environment.

The Wechsler-Bellevue Intelligence Scale (1939) became the first in a series of tests that have developed into a wide variety of intelligence tests that exist today

including; the Wechsler Preschool and Primary scale for Children-III (ages 4-6.5 yrs.), the Wechsler Intelligence Scale for Children (ages 6-16), the Wechsler Adult Intelligence Scale and the Wechsler Non-Verbal Scale of Ability (ages over 16 yrs.). What is interesting about the Wechsler tests is that they are not only used as a tool for measuring I.Q (intelligence) but are also used as a clinical tool to inform educators around interventions.

With the introduction of Public Law-142 (The Education of All Handicapped Children Act of 1975) which legislated for the assessment and diagnosis of all children with special needs, a variety of tests were developed and revised. Currently the most commonly used tests by psychologists include the Wechsler tests, the Stanford-Binet (SB5), the Woodcock-Johnson test of cognitive ability (WJ-III), the Kaufman Assessment Battery for Children (K-ABC) and the British Ability Scales (BAS3). The Wechsler tests are the most commonly used tests in Ireland among psychologists working in the National Educational Psychological Service (Survey taken in 2014 internally in NEPS).

The development of a theory of intelligence has been described by Kamphaus, Petoskey and Morgan (1997) as occurring in four waves: each wave influenced by the needs of society (or more specifically, governments) and a need for more scientific knowledge as each progression in intelligence testing developed.

Frist wave: The initial first wave is described as a purely pragmatic quantification of general levels of intelligence amongst individuals. The original Stanford-Binet test developed in the U.S is an example of an intelligence test that categorises individuals on the basis of their general level of ability. Using a general level of measured intelligence or g (conceptualised by Spearman in 1925) these tests

were had categories such as “Idiots” “Imbeciles” and “Morons”. Spearman had developed a statistical method of correlating different tests to a general intelligence (g) which operationalised the idea of learnt knowledge and knowledge that could be used for problem-solving or induction.

Second Wave: This wave is noted for a shift from the testing of general abilities to focusing on the subtests that measured g and their relationship with individual performance (Kamphaus 1997). The distinction between verbal and non-verbal modalities was investigated using statistical analysis with an emphasis on measuring specific abilities and their correlate predictability with g. Wechsler had argued that “we do not presume that there are different kinds of intelligence e.g. Verbal, Manipulative etc. it merely implies that there are different ways in which intelligence may manifest itself” (Wechsler, 1958, p. 164). Spearman had shown a correlation between g and academic ability and had theorised that “Every normal man, woman, and child is ... a genius at something ... It remains to discover at what ...” (Spearman, 1925, p436). For Spearman, the measurement of g focused on a broad ability and individual performance was of secondary importance.

Wechsler had suggested that it could be useful to look at an individual’s performance on subtests (both verbal and nonverbal) to see strengths and area of weakness. This was for the purpose of diagnosis and educational interventions. Again, the idea that knowing an individual’s general ability, areas of strength and weakness could inform an intervention was quite revolutionary. Public Law 94-142 had operationalised the idea of an individual education programme for children with special needs which, presumably, is what an

assessment should be about rather than the simplistic categorisation of individuals.

Third Wave: The theory that subtests could be interpreted individually to identify strengths and weakness within an individual's performance was challenged by the work of Cohen (1959). He argued that factor analysis of individual subtests and the verbal-nonverbal distinction produced very poor specificity, reliability and specific variance. This contradicted the idea and practice of individual subtest performance within an individual's profile was valid. It was an important development in the history of intelligence testing as it led to much more investigation and statistical analysis around the sampling and norming of populations. Kaufman (2004) has shown that individual profile analysis (Ipsative analysis) has not been supported by research (see also Hale, Hale and Landino, Kavale and Forness (1984) and Glutting, Mc Dermot and Konold (1997)).

The debate is on-going and Kaufman (2004) has responded to these arguments against individual subtest analysis by stating that an individual's subtest profile is not used in isolation but rather as an index / battery (a cluster of subtests such a Verbal Comprehension, Perceptual Reasoning and Working Memory etc.) performance which is used in terms of a statistical difference using the general normative sample. The Wechsler tests are the benchmark of I.Q testing due to their large sample size, the inclusion of Deaf and other minorities and the statistical correlation between I.Q scores and academic outcomes. The W.I.S.C. IVU.K (2004) gives four measures of I.Q: Verbal comprehension, Perceptual Reasoning, Working memory and Processing Speed. These four index scores are used to calculate the Full-Scale I.Q or FSIQ.

Appendix C. Different Perspectives on Intelligence.

Multiple Intelligences.

The concept that intelligence is much broader than that measured by I.Q tests was posited by Howard Gardner in his book “Frames of Mind: the Theory of Multiple Intelligences” (1983). Gardner posited that there are at least seven different types of “intelligence” and suggested that they were separate and innate to an individual. These intelligences were listed as; Musical, Kinaesthetic, Logical mathematical, Linguistics, Visual-Spatial, Interpersonal and Intrapersonal. He later added more intelligences including Naturalistic, Moral and Existential (Szpringer, Kopik and Formella, 2014). Accordingly, there seems to be “eight and a half intelligences” at the moment (Gardner, 2009a. P18).

Gardner argued that each intelligence could be identified as unique due to the fact that they can be isolated within the brain (by studying brain-damaged individuals), its place in evolutionary history, a distinct development progression, the existence of savants, prodigies and other exceptional individuals and support from psychometric findings (Gardner, 1983).

The traditional method of measuring intelligence in schools revolves around mathematical and linguistic skills (Czaja-Chudyba, 2005) where the reality is that intelligence tests (sic) test what academically bright students are good at (Gardner, 2009). Gardner argued that educational institutions teach to the skill-set of the able and can often ignore or undermine the strengths of other less academic students. This is an argument that is hard to contest in Ireland for example where “grind schools” abound and where terminal examinations measure a student’s ability to enter college and further education. There is a points system in Ireland which allocates certain points to test scores in the

Leaving Certificate test taken by students leaving second level education. As there is always more candidates than places in University courses, students compete for limited places in a series of tests that are taken of two-three hours during the month of June every year. There are no points for being good or “intelligence” in music (unless one takes music as an exam) or intrapersonal skills/intelligence.

Gardner argues that intelligence is “an ability to solve problems or create products which are specifically important in a particular environment and cultural or social context” (Gardner, 2009a. p18). Education should then, encourage and promote the different “intelligences” in students so that they can grow and develop as rounded human beings capable of contributing to society.

Criticisms of Multiple Intelligences Theory.

While the theory of Multiple Intelligences is quite popular and is often used in school settings (Szpringer et al, 2014) it has been challenged by some of the leading proponents within the academic community. Sternberg (1983), Scarr (1985) and White (2006) have all argued that Gardner has simply switched the word “intelligence” for what is commonly called “ability” or “Talent”.

Gardner never developed a test for Multiple Intelligences nor indeed proposed that it be test. A result of this is that scientific enquiry has been difficult in terms of developing correlational scores for each of the multiple intelligences. This is one of the main arguments against multiple intelligences: psychometrics demands scientific rigour and yet this concept is not strictly scientific: Gardner specifically argued that it is more about “artistic judgement than of scientific assessment” (Gardner, 1983, P248). Gottfredson (2006) has highlighted the absence of

empirical studies of Multiple Intelligences and argued that Multiple Intelligences as a concept is very attractive as everyone gets to be a winner (as such). Other commentaries have been less positive, for example, Murray and Herrnstein (1994, p18) stated that Gardner's Multiple Intelligences "devoid of psychometric or other quantitative evidence" and argue for the classical tradition of scientific evidence, scientific proof and an approach that has "given the world a treasure of information" (ibid, p19).

Notwithstanding Murray and Herrnstein's commentary, several researchers have attempted to link the theory of Multiple Intelligences to academic outcomes and other life outcomes. Szpringer, Kopik and Formella (2014, p353) have stated that Gardner's Multiple Intelligences theory has "revolutionised the way thinking about human intelligence and abilities". In their work they have used the Child Observation Questionnaire for teachers and Parents (Kopic and Zatorska, 2010)- a questionnaire that can be used to indicate "strong" points and directions of special abilities. The process can then be used to individualise education plans for children. Some issues around this methodological approach include a questionnaire that identifies strengths in a child by observation and the concept of "special abilities" (Kopic and Zatorska ibid,p 355). This questionnaire does not specifically refer to multiple intelligences and the observation of "special abilities" in a child can occur without reference to Multiple Intelligences. One might expect that most teachers keen to work through a child's strengths would complete such observations.

In a research paper linking high intelligence students to common and domain-specific cognitive characteristics, Song and Porath (2005, p236.) did not even

include the concept of Multiple Intelligences as it “posits that there is an information processing device in each intelligence that is unique to that particular intelligence, not common across all intelligences”. They argued that Jensen’s (2002) thesis that there is a ubiquitous presence of g in all tests. Birsen Ekinçi (2014) calculated the relationship between Gardner’s Multiple Intelligences and academic achievement and found that only Linguistic and Logical Mathematical Intelligences were only partially correlated to academic achievement. Ekinçi (Ibid, p632) states that “the multiple intelligences scores did not indicate the actual performance of the children in each type of intelligence”.

Emotional Intelligence.

The concept of Emotional Intelligence was brought to the public with Daniel Goleman’s 1995’s book “Emotional Intelligence why it can matter more than I.Q”. Goleman argued that I.Q is mainly a predictor of academic success while it takes more than academic success to survive and thrive in the world. He defined emotional intelligence as the “ability to monitor one’s own and other people’s emotions, to discriminate between different emotions and label them appropriately and to use emotional information to guide thinking and behaviour” (Goleman, 1995, p23).

Salovey and Mayer (1990) have developed a model of Emotional Intelligence which includes four strands: Perceiving emotions, Using emotions, Understanding Emotions and Managing Emotions. They developed the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT, 2002) which is was “Developed from an intelligence-testing tradition formed by the emerging scientific understanding of emotions and their function” (p2).

Some difficulties with this test include the fact that there are no “right” answers to the questions on the MSCEIT) and the fact that it is aimed at ages seventeen and upwards. The test then, is not scientific in the “intelligence-testing tradition” and is answers are seen as “intelligent” when the majority of respondents give this answer. The intelligence tests utilised in educational psychology in Ireland have “correct” answers and “incorrect” answers which differ significantly from the MSCEIT. Ivcevic, Brackett and Mayer, (2007, p199) state this problem very clearly: “Intelligence is the capacity to reason validly about a domain of information and it typically requires converging on a single answer”

Other tests have been developed including the EQ-I, (Bar-on, 2006) the Swinburne University Emotional Intelligence Test (SUEIT, Palmer & Stough, 2000) and the Schutte EI Model (Schutte, 1998) and are commonly used in business settings. These tests are mainly self-report and self-scored tests which are open to participants telling untruths or overestimating their ability (Holtgraves, 2004 and Paulhus, 2002). Robert Tell (2012) has shown that college students with higher g were much more likely to fake self-report items on tests of Emotional Intelligence.

Wu and Stemler (2008) have studied the relationship between self-reported Emotional Intelligence tests and Resident Advisor (students who offer support to freshmen entering college). They reported that Emotional Intelligence was not correlated to Resident Advisor ratings. Landy (2005) has shown that there are very few validity studies conducted on Emotional Intelligence tests and that it does not predict success in terms of academic or work based outcomes. Ivcevic, Brackett and Mayer, (2007, p210) have found only a very moderate correlation between scores on the MSCEIT and verbal and maths scores on SAT in the

USA. They suggest that the two tests are in fact measuring two different abilities. If this is the case, researchers may have to decide which “intelligence” is the real one. Wu and Stemler (ibid) note that employers in the United States invariably use g as a way of discriminating between candidates in a job competition.

Melanie Schulte (2004, p1059) has clearly stated that we must question the “uniqueness of Emotional Intelligence as a construct and conclude that its potential for advancing our understanding of human performance may be limited”.

While Emotional Intelligence is an interesting concept in terms of measuring success, it has very little traction in school-based assessment. As young children grow into adolescents and mature towards a school leaving age they develop, mature and sometimes master the art or ability to interact successfully with others and become more aware of their own inner thoughts and motivations. Much in line with Maslow’s (1943) Hierarchy of Needs, one moves towards developing a health self-esteem towards Self-Actualisation. Maslow identified this process as a life-long project and one which is not always attained by everyone. Follesdal (2009) has aptly shown the difference between thinking one has emotional intelligence and actually being rated as having E.I. He tested 111 business managers and compared their self-reporting to employees’ ratings. There was no correlation between the manager’s self-report if E.I and how their employee rated them. Indeed, Victor Lipman in his article in Forbes Magazine has noted the “disturbing link between psychopathy and leadership in companies (Forbes Magazine, 25/04/2013).

Appendix D. Testing Intelligence in a Nonverbal Way.

Since the first known non-verbal assessment of the Wild Boy of Aveyron (Carrey, 1995) many psychologists have tried to develop nonverbal means of assessing g. One of the most influential psychologists in this area was Seguin (1907) who developed puzzles using shapes which fit into a jigsaw-like form board which has been modified consistently and is still in use today. Another major contributor to the use of nonverbal testing was G. Arthur who produced the Arthur Point Scale of Performance test (1943, 1947). This test included the Seguin Form Board, the Knox Cube Test (a forerunner of Block Design) and the Healy Picture Completion test. Arthur believed that his test would be on a par with the Stanford-Binet test in terms of measuring I.Q (intelligence). The Point scale was specifically intended for Deaf and Hard of Hearing individuals. Its goal was to provide a nonverbal battery of tests that would eliminate the language-loaded aspect of intelligence tests (McCallum, Bracken and Wasserman, 2001, p4).

As highlighted previously, there has always been a need to administer nonverbal tests to individuals and the key demand was that they were “culture fair” (McCallum, Bracken and Wasserman, 2001). However, Braden (1999) argued that, rather than aiming at producing culture fair tests, psychologists should endeavor to produce tests that measured intelligence (g) in a way that was independent of culture. Early attempts to produce nonverbal culture-free tests include the Leiter International Performance Scale (Leiter, 1959, 1997), Draw a Person (Goodenough, 1926) and the Columbia Mental Maturity Scale (Burgemeister, Blum and Lorge, 1972). However, a combination of allowing the norms to become outdated and preference for the usage of Performance index/ batteries on wider language laden tests ensured that these earlier nonverbal tests

fell into disuse. Bracken (1986 and Kaufman 1990 and 1994) have highlighted the fact that Performance subtests on much of the Wechsler tests have large amounts of lengthy verbal instructions and basic language concepts. Yet it is a commonplace practice to use these tests on Deaf and Hard of Hearing Individuals in Ireland (NEPS, 2012).

McCallum, Bracken and Wasserman (2001) have noted that increased awareness among psychologists about the limitations of using Performance index/batteries to assess g has led to a demand for more sophisticated and updated nonverbal tests. The list of non-verbal tests available to psychologists has grown in the last decade to include: The Leiter International Performance Scale (1997), the Raven's Progressive Matrices (1999), Test of Nonverbal Intelligence (1997), the Naglieri Nonverbal Ability Test (1996) and the Universal Nonverbal Intelligence Test (1998). The Wechsler Nonverbal Test of Ability (2006) is the most modern test available to psychologists and has been specifically designed for specialist groups such as the Deaf and Hard of Hearing, students presenting g with selective mutism and non-English speaking students (Brunnert, Naglieri and Hardy-Braz (2009, p6). It was the first cognitive test to be linked to data collected by Gallaudet University annual demographic survey of tens of thousands of Deaf and hard of Hearing students in the United States. It is also the first cognitive test to report separate validity studies for Deaf and hard of Hearing students. It specifically "measures general ability nonverbally" (Brunnert, Naglieri and Hardy-Braz, 2009, p55).

Appendix E. Semi-structured questions used for interviews

Question one: What did you think about the tests? Most participants

Question two: Which one did you prefer doing?

Question Three: Did you like doing any particular test?

Question four: Why? (Did you prefer the subtest you picked out in question three).

Question five: You know that we were working on intelligence testing... what do you think makes a person intelligent or clever?

Question Six: If I said that you were intelligent what do you think I would mean?

Question seven: Can you tell me something you did that shows that you were really intelligent or really smart?

Question eight: How would you describe someone who was not intelligent?

Appendix F Simplified version for School Students

Hello, my name is Paul and I am an educational psychologist studying in the University of East London at the moment. Part of my study is where I have to do what they call “research”. This means that I have to go out and find out information about something interesting.

I am really interested in how young people like you show how smart you are. Because you are Deaf it can be hard for psychologists like me to show all your great skills and abilities. This is because we hardly ever know how to sign or know what tests are best to use. So part of my research is to find out what is the best way to find out how smart Deaf students are. I hope that you will work with me to find this out. It means that we have to work together for about two hours to try different tests and learn more about how smart you are.

The most important thing that you should know is that no-one will know who you are. This is called confidentiality. It means that I keep any information about who you are, where you are from or what scores you get on my tests. No-one outside of your family will know your scores unless you decide to share this with others. I use your scores and put them with other students’ scores to learn more and tell others about what I have found – but they won’t know who you are. This means that you only have to try do your best for you as no-one else will know about your scores.

You do not have to get involved if you think it might not be interesting or whether you might get upset in any way. You can even stop whenever you want. This is

not a problem. All you have to say is “I don’t want to be involved” or “I want to stop” and that is it.

I have asked your parents permission to talk to you about this and they have said that it is Ok. But this doesn’t mean that you have to work with me even if they want you to.

The research will be done in at the school grounds at a new place called the Centre for Deaf Research as you won’t be at school or be seen by your friends going to meet with me. Many of your friends might work with me but this does not mean that you have to.

I will meet up with you again at a time when we all agree and I will show you what I have learned from your test and how I think you might work on some areas. I will also show you what things you are good at so this might help you in school or in the future, at college or at work. If you think you would like to work with me please sign the consent form if you have had time to think about this and are happy to work with me.

Declaration

Child's assent to participate

I have read this consent form (or had it explained to me fully) and I agree to take part in this research.

Name of Child _____

Signature_____

Date ____/____/____

Parent or guardian's consent to allow the child to participate

I have read this consent form and discussed it with my child. I have had time to consider whether my child will take part in this study. I understand that his/her participation is voluntary (it is his or her choice) and that we are free to withdraw from the research at any time without disadvantage. I agree that my child may take part in this research.

Name of Parent or Guardian (in block letters)

Signature_____

Date ____/____/____

Appendix G. Sample Report.

Pól Bond

Registered Educational Psychologist

B.A (hons), H.Dip in Ed., DCRD, BSC (psychology), M.Ed., MAEP.

NEPS. Donore Industrial Estate, Donore Rd, Drogheda, Co Louth.

XXX participated in research undertaken by Pól Bond, Educational Psychologist.

The aim of the research was to see how a student performed on two cognitive tests: one which included a measure of verbal ability and a test of non-verbal ability. Tests used were the WISC IV (The Wechsler Intelligence Scales for Children fourth U.K edition and the Wechsler Nonverbal Scale of Ability.

Where the student used Irish Sign Language (ISL) as their primary form of communication, the WISC IV was administered through ISI by a professional interpreter. When a student had a hearing impairment they were offered the test verbally with the aid of an interpreter offering supplemental ISL support and language scaffolding. At all times the preferred mode of communication of the student was used. Students signed, spoke or used gestures to signal answers.

The WISC IVUK is a commonly used test by Educational psychologists in Ireland even though there are no Irish norms. It is mainly used to establish an understanding of where a student is performing in terms of their cognitive ability. This is commonly referred to as “I.Q” testing. However, the test can and is used as a sophisticated tool for uncovering strengths and areas of deficit. It focuses on four main categories that have been clinically associated with general intelligence

over the years (Flannigan and Kaufman, 2004) (Prifitera, Saklofske and Holdnack, 2006).

These four categories include:

Verbal Comprehension (How we understand language, express ourselves verbally and how to categorise and associate words and their meanings).

Perceptual Reasoning (Our basic problem solving ability, how we think and puzzle things visually)

Working Memory (Formally known as “Freedom from distractibility: being able to concentrate for short periods of time (1-6 seconds) to remember information and be able to change how you remember things-very important for memory in general).

Processing Speed (How quickly we can scan for information, clerical speed and quickness of hand-eye co-ordination).

A student is given a minimum of ten tests which go toward a standardised score in each of the four categories. If the four standardised scores are relatively similar we then calculate a Full Scale I.Q score which is usually given in descriptive terms rather than as a “Score”. There are several reasons for this: we work on the statistical probability that the score will come within a range rather than a particular point, this score can vary from time to time as there are many factors which can influence a student’s performance such as tiredness, anxiety, personality and surroundings. Descriptive terms used by psychologists range from “Very Superior, Superior, High Average, Average, Low Average, Borderline, Mild to Extremely Low”.

Therefore, an “I.Q” score should be taken to be a student’s performance on a particular day within a particular context. If all the factors are taken into account, the score predicts what a student is capable of. A person scoring in the Low Average range can do very well in school and exams with proper support and motivation. A person scoring in the High Average range should do well in school but may find school lacking in challenging activities and may “tune out” and become de-motivated. There are many individuals who have left school early or who did not learn how to read and do mathematics that have become very successful. Likewise, there are many “bright” people who have not matched the high standards of achievement they were capable of. Traditionally Deaf / Hearing Impaired students were given the Perceptual Reasoning Category as this is seen as being “less verbal” or requiring less language; however the three tests involve language input in terms of instructions and comprehension.

Sometimes a student will display a scatter of high and low scores and we may have to focus in on just two categories to establish an ability score: this is when we use a General Ability Index and use Verbal Comprehension and Perceptual Reasoning only.

There are also times when a student displays an unusual scatter of scores within a category. This is called a non-unitary construct (score) and means that we cannot simply average out the score and suggest that this score somehow represents all the high and low scores. It does not.

Wechsler Nonverbal Scale of Ability (WNV)

Author(s): David Wechsler and Jack A. Naglieri. The WNV is a test used for students who may have some communication or language difficulties. It is

specifically designed for students who do not call English their first language. It is used to bypass difficulties with overly verbal instructions and uses a minimum of gestures. Like the WISC IV it tests areas/categories that are clinically proven to be linked to General intelligence.

They test perceptual reasoning, processing speed, working memory and visual problem solving.

Younger students (aged 4 to 7:11) are given either two or four tests: Matrices, Coding, Object Assembly and Recognition (roughly translated as “what come next”? copying symbols against the clock, jigsaw puzzles and memorising shapes).

Older Students (8-21) are also given either two or four tests: Matrices, Coding, Spatial Span and Picture Arrangement (Spatial Span is a visual memory test and Picture Arrangement is using pictures to tell a sequenced story).

Again this test can be used to highlight strengths and weakness within a student’s cognitive (learning) profile. I have also included how you would have scored had I completed the test using two subtests. Sometimes a psychologist will give just two tests as a student may have limited concentration or may have some physical problems that would impact on how quickly they can write in the Coding test, for example children with Cerebral Palsy or Dyspraxia).

“SO.....what is my I.Q?”

I will be giving you a table with four separate scores:

1. The overall WISC IV test score which includes the language category

2. The Perceptual Reasoning Category score as traditionally used in the past
3. The Wechsler Non Verbal four test score and,
4. The Wechsler Non Verbal two test score.

I will use all four tests to give an opinion as to where I suggest your cognitive ability lies. I will also use the high and low scores to suggest areas where you have performed well and where you need more work. Remember that I.Q is about potential! There is no substitute for hard work, good motivation and practice.

Name: XXX Aged YY

Category	High Average	Average	Low Average	Borderline	Mild General Learning Difficulty	Moderate learning Difficulty
Standard score	110-119	90-109	80-89	70-79	50-69	<50
Description	May need specialised intervention	Should be fine in school and do well with work and determination	Needs a bit more work and practice	Needs some learning support	Needs specialised input from a specialist educator	May possibly need to attend a specialist school
Where you scored on the WISC IV ^{UK}		Unable to calculate due to wide scatter				
WISC IV ^{UK} only using Perceptual Reasoning				X		
Where you scored when we did not use language (the WNV) Four subtests				X		
WNV Two test Score			X			

Areas of relative strength and weakness include: XXX's scores on the WISC IV were so scattered that it was impossible to calculate a Full Scale I.Q. His Verbal Comprehension score was quite weak and he requires specialist support to develop his language skills. XXX's processing Speed was within the Average

range and is as well developed as we would expect for a young man his age. However, both his Working Memory and Perceptual Reasoning scores would suggest that he needs considerable support to boost these skills. In terms of his performance on the non-verbal test, XXX produced scores that would suggest that his overall cognitive functioning is within the Borderline range and that he will need more support in school to fully access the curriculum. Clearly XXX is well capable of being very independent and his socially competent which suggests that he must be supported with an individual learning programme in school

Work that can be done to improve performances over time: See each of the four sections below and look for an * to see which items you might need or enjoy doing.

How to improve your Verbal Comprehension abilities:

Remember that Language usage and knowledge depends on use and exposure. Think about all the ways we learn language: by talking, by listening, by watching and by copying. Reading and understanding what we read is vital to building up our language skills and knowledge base. Things you can do at home and in school:

- *Talk about jobs some people have such as the Gardaí, Ambulance drivers and Teachers. Talk about what makes these people like each other (employed by the government, try to help people, uniforms (?)) and how they are not like each other. Make lists of jobs people do that help others in the medical field (Doctors, nurses, surgeons, nurses' aides etc.)
- *Make lists of categories such as car makes and models, dog breeds, famous films that begin with "The" in the title.

- *Think of opposite words to regularly used words (big-small, tall-short)
- *Liaise with a speech and language therapist for a home/school programme.
- *Widen your knowledge of colours beyond the traditional red, yellow, green, blue black etc.
- *Read and listen to stories and give a summary of the main point of the story, what you liked/disliked about it and how you might change the ending.
- *Develop a picture/ sign dictionary to build up your vocabulary.
- Look at a picture in a school book and describe what you see. Use the Userborne “First 1000 words” book to build up vocabulary and sign (if used).
- Discuss how you would plan a holiday and all the things you would need to bring with you.
- *Talk about your favorite book/song and why you like it so much. List other songs/ books that are similar.
- *Give a mini talk on a special subject (“street dancing” etc.) for one minute. If possible, video yourself and see how well you used the time to get your message across.
- *If you are a competent reader, read a passage and summarise the main points. If you are new to reading, listen to the story or watch the sign and tell the story back in your own words/signs.
- *Try basic crossword puzzles and word games.
- If ISL is your main way of communicating, practice “translating” a passage or a story into signed English using the “and’s” “The’s” etc.

- *Build up your level of sign and see if you can master the Dolche sight word lists up to the first three hundred words.
- Learn the definitions of words on this list.
- *Keep a diary to practice your English writing and language
Perceptual Reasoning (Problem solving).
- *Check out this website: <http://www.tangramgames.co.uk> and try do some
Tangram puzzles.
- Make jigsaws but not large ones! Try doing a 50 piece puzzle against the clock.
Make models and play with Lego shapes.
- Identify the 'odd one out'. Use "where's Wally Books" to see how quickly you can
spot Wally.
- *Talk about how you solve problems in your everyday life such as "how can I get
my bike fixed" or "how can I get some extra money for that special thing I really
want to buy"? Ask your parent/teacher to talk you through a problem like "what
would I do if I got lost in a city/forest?"
- *Complete puzzles like Sudoku or learn how to play chess/draughts.
- Learn a new skill on the computer like how to make a leaflet/ poster or how to use
Word art.
- Learn how to measure things like a patio or work out basic maths questions in
your head like "what is six fifty's?"
- *Play visual games and puzzles at eyecanlearn.com

- Play board games that require thinking skills like Cluedo and Battleship
- Play Hidden Object games at Bigfish.com
- *Access the curriculum through a differentiated approach: use teacher summaries and notes as well as using Mindmaps (Tony Buzan) and spider-web notes.
- *Use a spelling notebook to record common mistakes. Overlearn any common errors and try to eliminate these mistakes.
- *If possible buy “Fantastic Brain Games” or “Brilliant Brain games” books to improve on problem solving. (Both produced by Parragon Books and are available on Amazon.co.uk)

Working Memory suggestions:

- *Hunt for pairs of cards and play “go fish” and other card games.
- Play memory games such as “I went to the shop and I bought” or “I went to the zoo and I saw”. Do items alphabetically and then change items to more obscure less obvious ones such as replacing “I bought an apple” for “I bought an apricot”.
- Memorise days of the week, months of the year and basic facts such as “how many days are there in a year?”
- *Participate in planning an activity, deciding what must be done first, second etc., so that each step is well defined. Recall each step in proper sequence.
- Learn how to spell words that you use every day and words that you often get wrong
- *Use memory tricks such as word association or visual associations to learn important items at school or for home (see www.web-us.com/memory/mnemonic_techniques.htm)
- *Learn how to make good notes and aids for study by using “Mindmaps” by Tony Buzan ISBN number 9780007743858
- *Memory needs practice! Overlearn things like your times tables home phone and mobile numbers and important facts
- Try to memorise your favourite song or poem.
- Memorise information such as PPS numbers and addresses.
- Learn commonly used phrases and sayings such as “A fool and his money are...”

- *Make sure you understand what your teacher is working on. Ask questions and make sure you have mastered a topic before you move on. Do not wait till the end of a term or a final exam to try remembering topics.
- *Test yourself often to remember facts and meanings of words. Build up a notebook of words you either find hard to spell or words you did not understand when you read them first.
- *Watch more documentaries about the world and learn more “facts” such as capitols of European countries, famous people and public figures. Know where all the continents are on a map, know about famous people such as Martin Luther King.

Processing Speed

- Do simple and then more complex word searches
- Play “Hidden objects” games at Bigfish.com
- Cross off every “The” and “and” on a photocopied text book
- *Complete a maths times tables grid and build up speed and accuracy

5	X	9 =
2	-	1 =
3	+	7 =
9	X	0=

- Practice “Where’s Wally?” and Spot the Difference games
- Play tic tack toe against the clock.
- *Try learn how to speed read
- Play “fastest/slowest” Mi on the Wii.
- Play fine motor games such as marbles, kerplunk, buckaroo and No fleas on Fred
- See if your school can do the Jump Ahead programme with you.

Appendix H. Information gathering sheet

1. Name of student: _____

2. Date of birth: _____

3. Parent(s) names:

4. Contact numbers or e-mail:

5. School attending:

6. Any other schools attended?

7. Age at which hearing loss was identified:

8. Description of hearing loss: please tick

Description of hearing	Hearing Level in better ear
------------------------	-----------------------------

- | | |
|--------------------|----------------|
| a. Mild | ≤40 dB HL |
| b. Moderate | 41 to 70 dB HL |
| c. Severe | 71 to 95 dB HL |
| d. Profound | >95 dB HL |

9. Preferred communication mode? ISL, Signed English etc.? _____

10. Cochlear Implant? _____

11. Age at which implant was switched on? _____

12. Hearing Aids used? _____

13. Any additional physical or cognitive difficulties? _____

14. Do parents use ISL? _____

15. Are parent(s) Deaf? _____

[illegible]

Appendix I. Use of Working Memory Subtests in the WISC IVU.K and the WNV.

The administration and scoring manual of the WISC IVU.K (2004) identifies three subtests within the Working Memory index: Digit Span, Letter-Number Sequencing and Arithmetic. In table 1.4 the author produces advice for testers administering the WISC-IVU.K. to D/HOH examinees. The use of Digit Span is cautioned as the change in modality (Wechsler, 2004, p15) “May affect performance and interpretation” while the use of Letter-Number sequencing is not recommended. The author also identifies possible difficulties in the administration of the Arithmetic subtest as “interpretation may be difficult” and the test may “require additional modification”.

As Digit-Span and Letter-Number Sequencing are auditory tests of Working Memory, there is an issue around modification and interpretation: While Baddeley and Hitch (1974) identify the Visuo-spatial scratchpad and the Phonological loop as equal skills within the framework of the Working memory Model, they are separate skills. However, both modalities: short-term auditory working memory and short-term visual memory are also identified within the CHC model of intelligence or g. The issue here is not whether Working Memory is being tested, it the modality of how it is being tested. The difficulty that arises when using the WISC IVU.K. is that the examiner is adapting an auditory test into a visual test.

The WNV however is clear about the use of visual working memory in the subtests. Table 4.2 (Wechsler and Naglieri, 2006, p35) illustrates a reliability coefficient of .80 and .87 for Recognition and Spatial Span respectfully. These subtests utilise the construct of Short-term visual memory identified in the CHC

model (Flanagan and Kaufman, 2004, p36). The comparison between an auditory test and a visual test is noted and comparisons are carried out in the Results chapter.

Appendix J. Expression of Interest Note.

My name is _____ and I am interested in finding out more information about the study on the cognitive assessment of D/HOH children. My daughter/son is _____ years old and we live in County _____. My contact number is _____ (Or e-mail address is _____).

I realise that this is not a commitment to taking part in any research and that I will have to give informed consent if and when the research begins.

Signed _____

Please post of Pól Bond

National educational Psychological service

Donore Industrial Estate

Donore Rd.

Drogheda

Co Louth.

Appendix K. Replies from Participants.

Question one: What did you think about the tests? Most participants (Shortened to P1, P2 etc.) enjoyed doing the tests and answered this question with some form of evaluation (including self-evaluation):

“They were easy and hard” (P10)

“They were easy” (P9)

“They were good fun and I enjoyed doing them. Some of them were hard but I did well”. (P7)

“I liked them. I was good”. (P18)

“Good. I had a good day with you” (P32).

“O.K. It was O.K. I enjoyed them, well..kind of..they were hard” (P27)

“I feel like they test my intelligence. They were hard” (P31)

“I couldn’t understand them” (P30)

“Not good. They were too hard” (P29)

“I did not like doing them. They were too hard” (P14)

“They were hard Paul” (P11).

Question two: Which one did you prefer doing?

Twenty two participants indicated that they preferred doing the WNV test (P1, P2, P3, P4, P5, P6, P7, P8, P10, P11, P12, P13, P14, P16, P17, P20, P21, P22, P23, P25, P26, and P32). This was two-thirds of the participants or 66%. Answers varied in terms of the reason given such as:

“I liked the one that didn’t use sign” (P6) (also see P7)

“I liked the one where I didn’t sign and Amanda was not there” (P20) and a similar answer: “I liked the shorter one when it was just you and me” (P21).

“I liked the one that was short” and “I like the shorter one”.

“I liked the long one because I learnt new words from Amanda” (the Interpreter).
(P19)

“I liked the longer one but it was hard. I think the other one was too easy” (P24)

“I liked the one where Pól spoke to me and we signed” (P27).

“I preferred using the one where I signed because I need sign language to understand how to do the tests” (P28)

“I preferred the longer one as it was more varied and harder” (P33)

Question Three: Did you like doing any particular test?

Nine participants expressed a preference for the Block Design in the WISC-IV^{U.K} (P1, P6, P8, P9, P18, P24, P27, P32 and P33).

“I loved doing the blocks as I am practical and hate language tests” (P1)

“I liked the blocks best” (P6).

Ten participants reported that they preferred the Corsi Block test (P2, P3, P5, P10, P13, P16, P17, P22, P25 and P28).

“The blocks where I had to remember. I was good at that” (P2)

“I liked the picture one. I liked the one where the dog chased the man. I have a dog and he does that” (P7)

“The one with the story” (P26). “I liked the easy one, the second one” (P10)

“I liked the one that tests your memory I was better than you!” (P22)

Four participants preferred the Picture Arrangement test from the WNV (P7, P12, P20 and P26).

Question four: Why? (Did you prefer the subtest you picked out in question three?)

Sixteen participants stated that they picked a particular subtest as they were good at it and that was easy and fun for them to do (P2, P3, P5, P6, P8, P9, P10, P13, P14, P16, P18, P21, P22, P24, P25, and P32)

“It was easy and I am good at it” (P2)

“It was easy” (P5)

“They were fun and easy to do” (P13)

“I am good (at it) and it’s easy” (P21)

“It was easy and fun cos you tried to make me forget” (P25).

Four participants referred to the presence of a “story” and liking working with the storyline (P7, P10, P20 and P26).

“They were easy cos it was just telling a story” (P12)

“I like telling the story and I could change it” (P26)

“I like the story-some were funny” (P20)

“It was like my dog chasing people” (P7).

“I like being challenged to show what I can do” (P33)

“Because Paul tested how good my memory is and how good brain is- and how good me working” (P28).

“It was a good challenge and I liked getting the answers” (P31)

Four participants cited the absence of language as a reason for preferring a particular subtest (P1, P11, P27 and P30)

“I don’t like tests that are like the language tests Like I said” (P1)

“Cos I did not have to know the words and signs” (P11)

“I didn’t have to sign. I prefer not to sign as it is hard when I am thinking two things” (P27)

“It was pictures”. This clearly indicates that the D/HOH participants preferred tests which were visual in nature and that utilised their visual perceptual strengths.

Question five: You know that we were working on intelligence testing... what do you think makes a person intelligent or clever?

A total of twenty five participants answered this question by linking their response to school-based skills such as reading, maths and studying for school. P1,P2, P3,P4,P5,P7, P8, P9, P10, P11, P14, P16, P17, P18, P19, P21, P22, P23, P25, P27, P28, P30, P31 and P32. The main association was that intelligent/clever people are good at school:

“Someone who is clever is good at school and gets answers right” (P2)

“Someone who shows their cleverness in class like maths” (P3)

“I think a person who is intelligent is great at school and gets all their schoolwork right” (P4)

“A person is good if they get things right in school and are good at reading” (P9)

“I see clever person as a boy or girl who is good at reading and school” (P16)

“They read more and better than others and are better than people in their class” (P19)

“They would be good at school and reading. Reading is hard so you have to be good to do it” (P21)

“Having a good brain and thinking and using reasoning. Good at maths, good at remembering maths tables and poems off by heart. Thinking about English questions and remembering the meaning of words. I think a clever person is good at everything” (P28)

“Someone who likes to study and concentrate and focus a lot. Doesn’t really mix much and they stay alone and tell a lot about their life. Study History, Geography and Politics-they know a lot and they know a lot of languages and can talk to people- so I am no use”. (P31)

“They would be good with people and be able to help others” (P24)

“They would be good at most things. Not only school but with people too. You have to be good with people or there is no point in being intelligent” (P33)

“They get things right and are nice to people. They are nice” (P20)

“They are nice to people and kind too. They would also be very helpful cos they would help others” (P6)

“They would be good at English, Maths and be friendly and kind” (P12). This is a common response and reflects a social construct of what intelligence means. As discussed in Chapter One, intelligence is commonly associated with school-based academic performance and the D/HOH participants in this study accurately reflect commonly-held beliefs around this concept.

One Participant linked being clever/intelligent with experiencing happiness from getting things right: “They would be happy and get things right. That would make them happy” (P13) This could be linked in to getting things right at school and may be interpreted in this light.

Question Six: If I said that you were intelligent what do you think I would mean?

Twenty three participants responded to this question by referring to academic success, school achievement and school-based achievement (P1, P2, P3, P4, P5, P6, P9, P10, P12, P13, P14, P16, P17, P18, P21, P23, P24, P25, P26, P27, P28, P31 and P33).

“It means that I can learn things quickly like my maths” (P1)

“It would mean that I am good at school and I get my answers right” (P2)

“I would be good at reading and school. But I could still be intelligent and curious about life and that would make me clever” (P6)

“I am good at the tests you gave and am good at school” (P16)

“It would mean that I am good at reading” (P21). Again, it is quite common for the participants to link examples of being intelligence with school-based academic performance.

Four participants linked their answer to this question with interpersonal skills (P12, P20, P24 and P33)

“Well I am cos I help others in my class and am good to people and a good friend” (P24)

“I am intelligent cos my family tell me I am. I am good in school and am kind to others” (P12)

“I think it would mean that I am good both at school and with people” (33)

“You would day that I am nice to people” (P20). This is an interesting set of responses as they relate intelligence with interpersonal skills associated with Emotional Intelligence.

Four participants responded to this question by refuting that they were intelligent and stating that they did not have certain skills which made them “Not clever” (P11, P19, P22 and P30).

“I am not intelligent. I am not good at reading and I cannot sign words that others know” (P11)

“I am not clever as I do not read well. I am not good at that” (P19)

“I have been told that I am clever but I don’t think so (I. “**Why?**”) I just don’t.” (P22)

“I would be good at school but it is hard” (P30). These four responses may be indicative of participants thinking that they are not “intelligent” as they are, perhaps, not good at school-based, academic tasks.

P32 stated that “I am good with things that do not have language. I am good with pictures and puzzles”

Question seven: Can you tell me something you did that shows that you were really intelligent or really smart?

Again, the vast majority of participants (twenty three) responded to this question by linking it to school performance, reading, maths and getting answers right in school (P1, P2, P5, P7, P8, P9, P10, P12, P13, P14, P16, P17, P18, P19, P21, P22, P23, P25, P26, P27, P28, P30 and P31).

“I learned how to get good at maths” (P1)

“I am good at school and I work hard all the time” (P7)

“I can read and do my writing and that shows that I am clever” (P8)

“I got my spelling right and my maths right” (P16)

“I read in school and get my book finished” (P21)

“Last year I did a test and got everything right and I was very happy.” (P26)

Five participants responded to this question by giving examples of interpersonal skills such as being friendly and helpful/kind (P6, P11, P20, P24 and P33)

“I help others in school when I am finished my work and that shows that I am kind and clever” (P6)

“I help my friend in school and I help my mammy” (P20)

“I help my little brother and my mammy at home and I am good at that. My mammy says I am a great girl” (P11)

“I am always good to my friends and I help people” (P24)

“I am good with my friends. I listen and they tell me things about their problems and I help. I want to do that when I leave school” (P33). This links in directly to Emotional Intelligence, showing a wider understanding of what “intelligence” can mean.

Two participants answered with unique responses that linked intelligence to getting a part in a play (P4) and one who suggested that being clever is not necessarily linked with school life (P3):

“I got a part in a play that had hearing children in it. So I did really well to get the part. I was really good at acting and I want to be an actor” (P4)

“Well some people are just born like that. I mean if you don’t go to school you could still be clever. They don’t have to go to school and they don’t have to be reading-they can do other things like engineering.” (P3)

Question eight: How would you describe someone who was not intelligent?

Fourteen participants responded to this question by stating that a person who is not intelligent would be poor at reading specifically (P3, P6, P7, P8, P9, 10, P12, P16, P19, P21, P22, P26, P27 and P30)

“No good at reading” (P3)

“Not able to read (and write)” (P8)

“They would not be able to read.” (P6)

“They could not read. That means that they are stupid.” (P10)

“Not good at English and make lots of mistakes.” (P26).

Eight participants linked their response to not being good at school and not working at school (P1, P2, P4, P5, P17, P23, P25 and P32)

“They would not put the effort in and would give up easily. They wouldn’t be able to do their homework every day.” (P1)

“That do not work and do not try in school.” (P2)

“Dumb-doing nothing in school and not learning. Too laid back and not working.” (P17)

Three participants linked their response to interpersonal skills around being helpful and being selfish (P11, P24 and P33)

“They don’t care about school or their friends and just look after themselves.” (P33)

“They are not helpful and are selfish.” (P24)

“They would not help their mammy and would be bold.” (P11).

P18 stated that “They would be messy and not be able to put their clothes on right. They would be stupid.”

While P28 stated that “If a person is not clever they are not good at soccer”.

Appendix L. Ethics Form and Approval Letter.

ETHICAL PRACTICE CHECKLIST (Professional Doctorates)

SUPERVISOR: Sharon Cahill

ASSESSOR: James Walsh

STUDENT: Pol Bond

DATE (sent to assessor): 27/02/2012

Proposed research topic: “Measuring Deaf Intelligence: a comparative analysis of two methods of assessing deaf students. Best practice for educational psychologists”

Course: Professional Doctorate in Applied Educational and Child Psychology

- | | |
|--|-----|
| 1. Will free and informed consent of participants be obtained? | YES |
| 2. If there is any deception is it justified? | N/A |
| 3. Will information obtained remain confidential? | YES |
| 4. Will participants be made aware of their right to withdraw at any time? | YES |
| 5. Will participants be adequately debriefed? | YES |
| 6. If this study involves observation does it respect participants' privacy? | NA |
| 7. If the proposal involves participants whose free and informed consent may be in question (e.g. for reasons of age, mental or emotional incapacity), are they treated ethically? | YES |
| 8. Is procedure that might cause distress to participants ethical? | NA |

9. If there are inducements to take part in the project is this ethical? NA

10. If there are any other ethical issues involved, are they a problem? NO

APPROVED

YES		
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MINOR SUGGESTIONS: Student might be advised to use his work address (rather than his home address) in the parents' information letter. Also, check spelling of Cabra is same letter.

REASONS FOR NON APPROVAL:

Assessor initials: JW

Date: 12th March 2012

RESEARCHER RISK ASSESSMENT CHECKLIST (BSc/MSc/MA)

SUPERVISOR: Sharon Cahill

ASSESSOR: James Walsh

STUDENT: Pol Bond

DATE (sent to assessor): 27/02/2012

Proposed research topic: "Measuring Deaf Intelligence: a comparative analysis of two methods of assessing deaf students. Best practice for educational psychologists"

Course: Professional Doctorate in Applied Educational and Child Psychology

Would the proposed project expose the researcher to any of the following kinds of hazard?

1 Emotional NO

2. Physical NO

3. Other NO

(e.g. health & safety issues)

If you've answered YES to any of the above please estimate the chance of the researcher being harmed as: HIGH / MED / LOW

APPROVED

YES		
-----	--	--

MINOR CONDITIONS:

REASONS FOR NON APPROVAL:

Assessor initials: JW Date: 12th March 2012

SCHOOL OF PSYCHOLOGY

Dean: Professor Mark N. O. Davies, PhD, CPsychol, CBiol.

UEL
University of
East London
www.uel.ac.uk

School of Psychology
Professional Doctorate Programmes

To Whom It May Concern:

This is to confirm that the Professional Doctorate candidate named in the attached ethics approval is conducting research as part of the requirements of the Professional Doctorate programme on which he/she is enrolled.

The Research Ethics Committee of the School of Psychology, University of East London, has approved this candidate's research ethics application and he/she is therefore covered by the University's indemnity insurance policy while conducting the research. This policy should normally cover for any untoward event. The University does not offer 'no fault' cover, so in the event of an untoward occurrence leading to a claim against the institution, the claimant would be obliged to bring an action against the University and seek compensation through the courts.

As the candidate is a student of the University of East London, the University will act as the sponsor of his/her research. UEL will also fund expenses arising from the research, such as photocopying and postage.

Yours faithfully,



Dr. Mark Finn

Chair of the School of Psychology Ethics Sub-Committee

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Appendix M. Information on the WNV.

Reliability.

The average reliability coefficient for both the Full Scale scores (Two and Four test batteries) were described by Naglieri (2006) as “good” with values of .91 for both the Four and Two subtest batteries. Evidence of internal consistency reliability was obtained for Deaf and Hard of Hearing groups also and were described as “similar to or higher than those coefficients reported for the normative sample” (Ibid, p35) and suggests that the WNV is an equally reliable tool for the assessment of examinees who are D/HOH. The WNV Technical and Administrative manual illustrates the evidence of reliability using the Coding subtest and reporting a reliability coefficient of .91 for both the Four Test and Two Test full scale score. Test-retest reliability are reported as equal to, or better than, other Wechsler tests and are described as “average to good” across all age ranges.

Validity.

The validity of a test is a fundamental aspect of any test evaluation. Test content measures the degree to which test items accurately test the trait that is supposed to be measured. In this case the WNV test items are supposed to be testing g or general intelligence. The correlations between the Four Test full scale scores and the Two Test full scale scores were reported as being .88 for the Four Test full scale and .73 for the Two Test full scale.

Correlations were also calculated against the Wechsler Preschool and Primary aged Scale of Intelligence III (1989). Results show a “moderate” (p, 52) correlation between the WIPPSI III and the WNV. A similar correlation calculation was completed between the WNV and the WISC IV (2003) indicating a “moderate” correlation of .66 between the Four and Two Test full scale score and the Perceptual

Reasoning Index of the WISC IV. All other correlates were lower, including with the Full Scale I.Q score of the WISC IV.

Interestingly, a correlation study between the WNV and the UNIT was also calculated. The UNIT (Universal Nonverbal Intelligence Test, Bracken and McCallum, 1998) is the only non-Wechsler test that was compared to the WNV. Correlations of .73 and .62 for the Four Test and Two Test batteries respectively indicate a moderate correlation. Wechsler and Naglieri (2006, p57) argue that “The magnitude of these correlations suggest that the two instruments measure a similar construct”.

Additional Information for working with Deaf and Hard of Hearing Students.

The WNV offers specific advice for examiners administering the WNV to D/HOH students based on the finding of Braden and Hannah (1998), Hardy-Braz (2004) and Wechsler (2003). However, due to the unique instructions of the WNV, there is little or no modifications needed to administer the tests to students who are D/HOH. The administration of the test utilises pictorial instructions and a minimum of verbal or signed interactions between the administrator and the student. It is worth noting that, although the WNV is considered to be an excellent way of assessing the cognitive ability of D/HOH students, the authors of the technical manual (Wechsler and Naglieri, (2006, p108) state that “further psychometric studies are needed to bolster the research across all aspects of culture and education, particularly with the Deaf and hard of hearing populations”.

They also suggest that “the administration of tests and interpretation of results with Deaf and Hard of Hearing individuals often requires specific training, communication skills, supervision and experience beyond the scope of these guidelines” (Wechsler and Naglieri, 2006, p 108). This would suggest that an inexperienced educational

psychologist without the requisite information and knowledge about Deaf culture, language and the specific challenges of assessing the cognitive ability of D/HOH, should not administer the WNV to these individuals even though the test is specifically designed for this population. It is clear that, as Bull (1998) has argued, the interviewing of parents who are deaf or hard of hearing needs specific communication skills such as ISL, ASL or BSL. This will impact on the establishment of Informed Consent among D/HOH parents/Guardians.

Wechsler and Naglieri (2006) also indicate that the presence of additional disabilities which can present co-morbidly with hearing impairment may be as high as 45% (Mitchell, 2004). Wechsler and Naglieri (*ibid*) identify the issue of D/HOH individuals presenting with co-morbid difficulties (see also, Brauer, Braden, Pollard and Hardy-Braz, 1998 and Marschark and Spencer, 2011); the term “Deaf” or “Hard of Hearing” represents a quite a heterogeneous group of individuals. The main challenge facing the research focus of this thesis was to find a group of individuals who present as D/HOH with no additional co-morbid difficulties, hence the focus of the recruitment for participants and the exclusionary rationale utilised.

The WNV manual offers subtest administration (Wechsler and Naglieri, 2006, p110) across four main communication modalities: Sign Language, Sign Supported English, Cued Speech (a sound-based visual communication system that makes all phonemes visually accessible) and Aural/Oral which is using speech and enhancing the sound with the use of hearing aids, lip reading or cochlear implants.

Wechsler and Naglieri (*ibid*) acknowledge that the examiner should always use the preferred communication mode of the examinee and that interpreters are a perfectly

acceptable accommodation for the administration of the tests where the examiner is not fluent in sign language.

Appendix N. The effect of Deafness on Brain Development.

Neville and Lawson (1987 a,b,c) have found that congenitally D/HOH adults showed ERPS (Event Related Brain Potentials) that were 5-6 times larger than that of hearing adults over both the left and right occipital regions. These brain regions are normally associated with visual analysis which suggests that D/HOH individuals have developed better visual analysis than their hearing peers. It also shows that language is associated with or linked to visual processing in the brain. This may explain the Performance-related advantages displayed by Braden (1994). Essentially, D/HOH individuals “see” language rather than hear it which makes sense of the fact that language centres in D/HOH brains are located in visual areas rather than auditory areas.

In a movement detection task, D/HOH adults showed ERP's 2-3 times larger than those of Hearing adults over the left temporal and parietal regions (Typically responsible for linguistic processing). D/HOH adults were faster and more accurate in detecting movement in peripheral vision than hearing adults. Neville and Lawton (Ibid) suggested that this ability was not due solely to hearing impairment but also whether the deaf person used ASL. They tested hearing adults who knew ASL and reported that D/HOH and Hearing adults who used ASL showed larger ERP's over the left rather than the right hemisphere. They argued that people who use sign language need to understand movement as it is linguistically salient. Movement patterns are grammatical and pragmatic for people who use sign and their brains respond appropriately.

Bosworth and Dobbins (1999) replicated the Neville and Lawson experiment and found that there were strong right visual field effects (i.e. left hemisphere) for D/HOH

adult signers in a motion detection task that utilised peripheral vision. Baveleir, Corina and Neville (1998) asked D/HOH native sign users and hearing adults who were unfamiliar with ASL to monitor changes in the luminance of displays of moving dots presented in peripheral vision and found that there were significant differences in favour of ASL users.

Neville (1993) has interpreted these results to mean that there are separate neurocortical effects for sensory compensation and acquiring a spatial grammar. They suggested that a way of checking this is to investigate individual cases on left and right hemisphere brain damaged adult D/HOH native sign language users (See Corina 1998 for a review). Like Hearing speakers, D/HOH native signers who suffer damage to the left posterior temporal region show serious ASL expressive language deficits (Corina, Kritchevsky and Bellugi (1996) but they can recognise pictures or do block design and face recognition tasks (which are non-language). Right hemisphere-damaged D/HOH signers show marked deficits performing visuospatial tasks like block design, face recognition but no or few deficits in ASL expression (Corina et al 1996 and Poizer, Klima and Bellugi (1987).

These case studies show a marked dissociation between language and non-language processes in terms of left and right hemisphere function which means that the brain organises its work by abstract cognitive function and not surface sensory form. The suggestion is that D/HOH individuals have developed more plasticity in terms of brain function: rather than a hemispheric dominance traditionally associated with language, D/HOH sign language users have both right and left hemisphere usage as sign language involves space, location for language usage and comprehension. However, there have been some indications that some studies on Hearing individuals identify neuroimaging indicating both left and right hemisphere

activation also present in spoken language processing (Poeppel, 1996). Chovan, Waldron and Rose (1988) report that D/HOH children employ visual strategies for a relatively broad range of cognitive tasks. . Hall and Bavelier (2010) have shown that visio-spatial memory for D/HOH individuals is as good as or better than their Hearing peers. Maller (1997) and Zwiebel and Mertens (1985) have previously shown that D/HOH children score better on subtests that are more visuo-spatial than the Hearing population. However, Chovan, Waldron and Rose (ibid) argue that while visual strategies are used as a preferential strategy, it does not imply that this strategy is more efficient. Emmorey and McCullough (2009), worked with “Codas” (Children of Deaf Adults) who simultaneously acquired a signed and spoken language from birth and reported that “Codas” have similar right and left hemispheric activity when signing. Bavelier, Brozinsky, Tomann, Mitchell, Neville and Liu (2001) noted that D/HOH individuals are better able to detect motion in periphery sightline than hearing individuals. All this evidence suggests that language areas traditionally associated with left brain regions are presenting in right brain activity in D/HOH and CODA populations.

Bavelier et al (2001) highlighted the evidence that Hearing and D/HOH ASL signers exhibit a superior ability to generate and transform mental images. In ASL and other signed languages, spatial descriptions are most commonly produced from the signer’s perspective, such that the addressee, who is usually facing the signer, must perform what amounts to a 180 degrees rotation thus enabling signers to develop different perspectives and acquire an ability to switch perspectives at will.

Keehner and Gathercole (2007) concluded that sign language experience, even when acquired in adulthood by hearing people, can give rise to adaptations in cognitive processes associated with the visual manipulation of visio-spatial

information. Several studies have shown that D/HOH and hearing ASL signers exhibit superior performance on the Benton Test of Face recognition compared to non-signers (Bellugi, O'Grady, Lillo-Martin, O'Grady, Van Hoek and Corina 1990, Bettger, Emmorey, McCullough and Bellugi 1997). The results suggest that both sign language experience and hearing impairment can affect neural organisation for recognising facial expressions.

In terms of visuo-spatial skills and memory, Bettger, Emmory and Bellugi (1997) found that ASL native signers, native Hearing (CODAS) signers and non-native D/HOH signers all performed more accurately on the Benton Test of facial recognition than hearing non signers. The evidence available suggests that learning and using sign language has been found to sharpen the visuospatial ability of recognising movement patterns and generating and mentally rotating mental images (Emmorey, Kosslyn and Bellugi 1993).

Fok, Bellugi, Van Hoek and Kilma (1988) found that Chinese D/HOH children who sign were better at memorising movement made in the air. Moreover, D/HOH children who do not sign do not display these skills/advantages (Chamberlain and Mayberry 1994). We can conclude from the research on D/HOH brain function and visual spatial skills that D/HOH and sign language users excel in visual perceptual skills and that they have greater fluidity in how their brain processes "Language". Hearing individuals, in the main, process language in the left hemisphere but D/HOH individuals and native CODA sign language users predominantly process language in the right hand side of the brain as most of their communication is through visual stimuli rather than auditory stimuli. D/HOH individuals "see" language and therefore process it through the visual parts of their brain which in turn makes them better than Hearing individuals at visual perception and discrimination which links into the high

Performance I.Q scores on older tests that did not use more subtle distinctions to measure nonverbal reasoning (Fluid Reasoning).

Hemispheric Dominance.

Repeated findings report that D/HOH children show reduced left hemisphere dominance for language due to their delayed and fragmented exposure to language in early childhood (Marcotte and LaBarba (1985, see also Ashton and Beasley 1982). There is also a larger than average preponderance of left-handed D/HOH children and adults (due to a dominant right brain, see Bonvillian Richards and Dooley 1997). Bonvillian Orlansky, and Garland (1982) have speculated that delayed language acquisition contributed to their reported left handedness.

